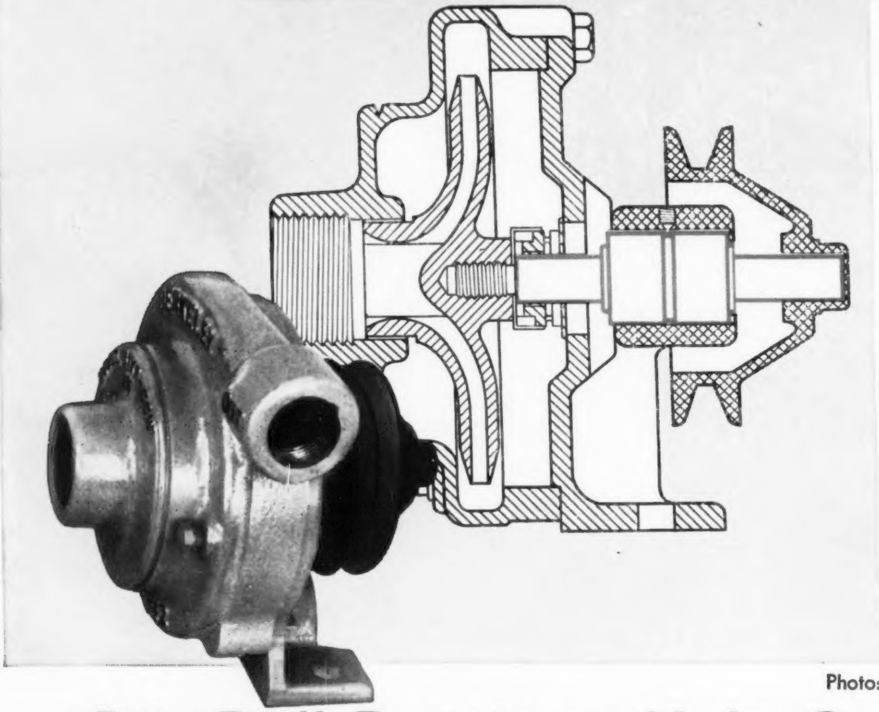
MARCH 1959

Agricultural Engineering

The Journal of the American Society of Agricultural Engineers

CASE HISTORIES



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Agricultural Engineering

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CONTENTS · **MARCH, 1959** · **Vol. 40, No. 3**

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JAMES BASSELMAN, *Editor and Publisher*

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The 1959 Yearbook

THE 1959 – Sixth Edition – AGRICULTURAL ENGINEERS YEARBOOK is in the hands of the printer and will be mailed early in April to all members of the American Society of Agricultural Engineers whose names are included in the active roll of members at the time of mailing. The price of the Yearbook is included in the annual membership dues paid by each ASAE member. The price to non-members of the ASAE is $5.00 per copy postpaid.

The Yearbook includes a variety of information about the American Society of Agricultural Engineers as an organization and about many of its activities – all brought together under one cover for readily accessible reference. The Yearbook is proving to be a most useful tool to ASAE members for the reason that it provides much information for which they have frequent need and which otherwise would be available only from many different and sometimes uncertain sources.

Of particular value to ASAE members is the fact that the contents of the Yearbook are brought up to date once every year. Not only is the material contained in preceding editions revised and improved, but much new material is being added each time it is reissued.

The Yearbook contains all the current ASAE-Approved Standards, Recommendations, Codes and Data, including those omitted from the 1958 edition. Proposed for addition this year, pending ASAE Council approval, are new standards for three-point free-link hitch attachment of implements to agricultural wheeled tractors, uniform terminology for bulk milk handling, uniform terminology for conditioning of harvested crops, and electric wiring recommendations for bulk milk cooling systems. Improvements have been made in minimum standards for irrigation equipment, and standards for design and installation of non-reinforced concrete irrigation pipe systems.

One section of the Yearbook is devoted to a directory of suppliers to agricultural engineers which contains a list of trade associations with activities related to agricultural engineering, a list of leading manufacturers of products having wide application in agriculture, and a classified list of manufactured products and the principal manufacturers of each.

A new feature this year is a summary of M.S. and Ph.D. theses submitted to agricultural engineering departments since those reported in May 1955 issue of AGRICULTURAL ENGINEERING. Other features of the Yearbook include the ASAE membership roster, lists of ASAE members who are engaged in consulting engineering services, ASAE officers, divisions, sections, colleges offering curriculums in agricultural engineering, student branches, and the constitution, by-laws and rules. A listing of the ASAE committees for 1958-59 will not be carried since they will be carried in the July issue of AGRICULTURAL ENGINEERING, at the beginning of the committee year.

In planning the material to be included in succeeding editions of the Yearbook, the editor is governed mainly by what appear to be the most obvious needs of the ASAE members in general. The aim, of course, is to make Yearbook contents of greatest possible usefulness to the largest number of members. To accomplish this purpose, the editor is constantly searching for new features that can be added. Ideas and suggestions from ASAE members are invited. Proposals and recommendations for ASAE committee action, and subsequent approval as ASAE Standards, Recommendations, Codes, and Data, are encouraged.

Report to Readers . . .

NEW FLIGHT-BAR DEVICE MAY BOOST CAPACITY OF COTTON GIN TENFOLD

An experimental cotton gin, developed by USDA agricultural engineers, has produced close to 20 pounds of extra-long-staple lint per inch of roller per hour. The average rate is about 2½ pounds for modern commercial roller gins. . . . . What is new about the new gin is a flight-bar attachment that replaces the vibrating knife used in conventional roller gins. This attachment is made up of two endless, sprocket-driven chains, to which square steel bars, each as long as the ginning roller, are fastened slatlike at 2-inch intervals. As seed cotton is fed into the gin, the lint adheres to this roller. A stationary knife, set close and parallel to the roller, holds back the seeds as the lint is pulled by the roller. The sprocket-driven chains pull the flight bars across the knife, which removes the seed as the fiber is pulled between knife and roller. The ginning operation is then completed by doffing the lint from the roller with a rotary brush or blast of air or steam. . . . . A conventional blower was also added to the gin, by means of which any mixed seed and lint, not separated the first time through, can be returned to the feeder. . . . . Further tests are to be made to determine mechanical limitations of the gin and cotton fiber and spinning qualities.

CROP SPRAYER-DUSTER APPLIES CHEMICALS EITHER WET OR DRY

A new sprayer-duster with several unusual design features has been developed by a USDA engineer-entomologist research team in cooperation with state ag experiment station researchers. A particular feature of the machine is its flexibility for either spraying or dusting. It is adjustable for use on low-growing crops of different row spacings, and the chemical-carrying booms may be moved both horizontally and vertically within the rows. This permits spray or dust nozzles mounted on the booms being operated at uniform height for accurate placement of chemicals on upper and under portions of plants. . . . . The researchers found combining sprayer and duster in one machine to be practical. For low-volume spraying, a supplemental air blast is essential to further atomize the spray as it leaves the nozzles. Since an air blast from a duster was deemed ideal for this purpose, spray nozzles were built onto a duster. As a result, this double-purpose unit permits applying chemicals wet or dry, as the need requires. It was also found that, with insecticides in current use, almost complete control of aphids was possible without significant mechanical damage to vines. . . . . The unit is powered by a row-crop tractor, to which a horizontal tubular drawbar is attached at right angles to the direction of travel. The sprayer-duster booms are attached to this drawbar by universal joints. The other ends of the booms ride on ski-like shoes that trail on the ground between rows. The nozzles on the booms are thus at a constant height and distance from the plants.

WATERSHED PROTECTION AND FLOOD PREVENTION WORKS EXCEED EXPECTATIONS

An SCS agricultural engineer told an ASAE meeting that the late spring floods in 1957, in the three states of Arkansas, Oklahoma, and Texas, did more than to emphasize the urgent need for more watershed-protection and flood-prevention works in that tri-state area. That the designs of the completed watershed structures were adequate and safe was demonstrated by the fact that at no time during the severe test from the floods were these structures in danger of failing. As a result, no major changes in methodology or design appear to be needed. It is the conclusion of the engineers that, if all feasible watershed flood-prevention structures had been completed at the time, more than 100 million dollars of flood-damage loss could have been avoided and several lives saved. . . . . The SCS watershed protection and flood prevention program includes proper land use and treatment in combination with such improvements as floodwater retarding structures, floodways, channel improvement, floodwater diversions, and sediment-control and grade-stabilization structures.

(Continued on page 120)

ARTIFICIAL CHICK ENSURES HEAT CONTROL IN BROODERS

A device that reacts much as do the chicks it keeps comfortable has been developed by a research team of USDA and Purdue AES agricultural engineers. It is simply a 4-inch black globe that operates under a chick brooder and loses heat by radiation and convection much like chicks lose heat to their surroundings. This control is more responsive to heat transfer by convection and radiation than are brooder controls now in use. . . . . The black globe is placed under the brooder lamp just above the litter. Its 105F temperature is maintained with two heat sources: some continuously through an electrical resistance element inside the globe, and the rest intermittently by the infrared brooding lamps. As chicks get older, they produce more heat and so require less of it to be supplied to them. By increasing the internal heat of the globe with age of the chicks allows this device to maintain its internal temperature in progressively cooler surroundings without additional heat from the brooder lamps. . . . . Rheostat settings for making birds of different ages comfortable have been determined from tests based on accepted brooder temperatures. These settings are then marked on the rheostat dial. . . . . One disadvantage of this new control is its high cost, thus limiting it to large installations where one unit can be used to control several brooders. Another disadvantage is the fact that rather complex servicing is required.

ACCESS OF THE AMERICAN ENGINEERS TO TECHNICAL LITERATURE SECOND TO NONE

At a U S Senate committee hearing last fall, a witness testified to the effect that American engineers are at a serious disadvantage in that they are unable to obtain up-to-date technical information as quickly and easily as their Russian counterparts. This was promptly refuted by the director of the Engineering Societies Library of New York, which maintains one of the nation's largest and most complete collections of technical literature. The director further stated that, comparing the state-operated technical libraries of the USSR with the non-profit Engineering Societies Library, which operates without government subsidy, the Soviet centralized information services are not essentially better than the services available in this country. He further observed significantly, "If the Soviets have profited more than we have from technical literature, one may believe they have worked harder at using it." . . . . There appears to be no quick, easy solution to difficulties imposed by the increasing flood of technical literature, but indexing and searching services are far from choked by it. It is apparent, however, that mechanical and electronic systems of storing information for quick access to large areas of information are many years in the future.

CANADIAN RESEARCHERS DEVELOP DEVICE TO MEASURE LEAF AREA

Since leaf area is an important factor in the photosynthetic capacity of a plant to produce dry matter, an adequate means for determining the area of leaves therefore becomes a valuable research tool. Agricultural engineers, in cooperation with forage crop specialists in the Canadian department of agriculture, have developed a simple photoelectric device that makes possible rapid and accurate measurement of leaf area. The unit was used in a genetic study of the leaf size of bird's-foot trefoil and proved to be a satisfactory instrument for the purpose.

ONE-WAY DISK HARROW PROVEN BEST FOR TRASH CONSERVATION

From field studies conducted in Alberta, it was found by Canadian researchers that, with shallow tillage and the equipment operating at moderate speed, best trash conservation was produced with the one-way disk harrow. At suitable speeds, it was found that 45 and 22 percent of the original surface trash was retained by shallow tillage after one and two passes, respectively, as compared with 27 and 12 percent for deep tillage.


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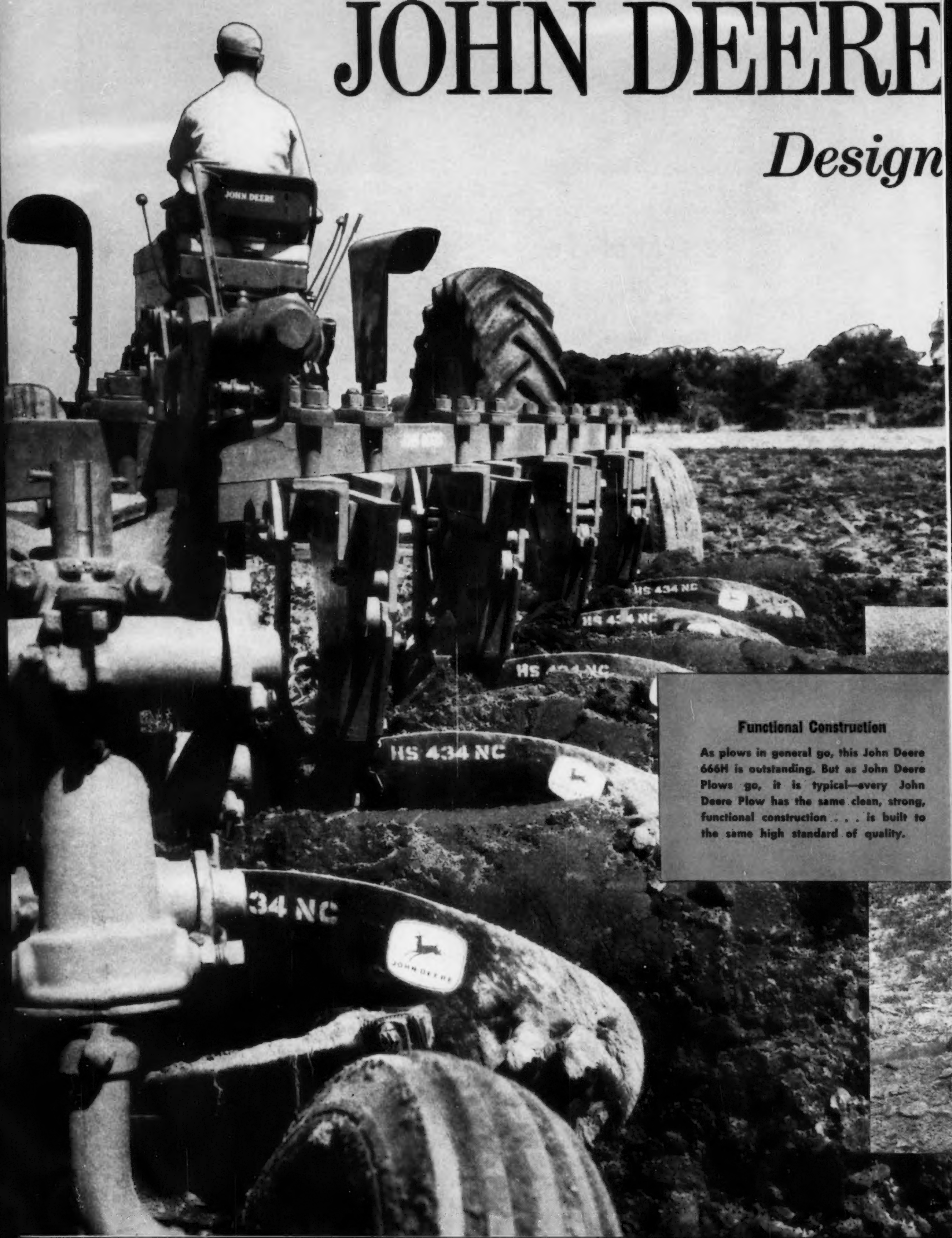

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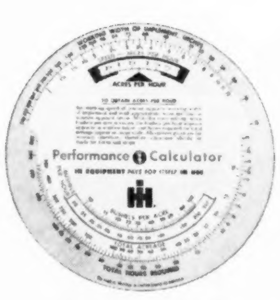

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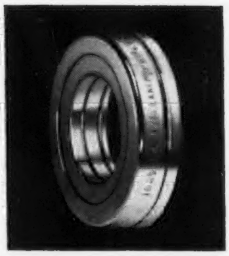
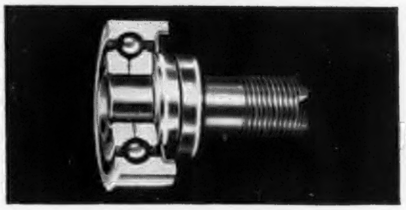
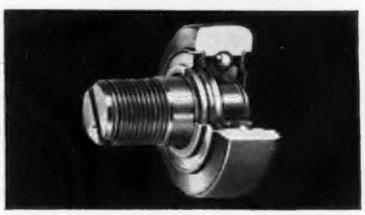


Clutch Bearings



Hay Rake Bearings

Idler Pulley Assemblies



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UNIVERSAL JOINTS AND DRIVE LINE ASSEMBLIES

Agricultural Engineering

March 1959
Number 3
Volume 40

James Basselman, *Editor*

Chaos or Order?

Guest Editorial by Mark E. Singley
Member ASAE

FUNDAMENTAL to the progress of science in particular and mankind in general is a system of measurements. As the world shrinks and mankind's progress accelerates, the importance of the system of measurements grows. Are we moving into the future with an outmoded system? Or is our present system acceptable but in need of overhauling? Section M, Engineering, of the American Association for the Advancement of Science, devoted its sessions during the December 1958 annual meeting in Washington, D. C. to a discussion of these questions. No conclusive answer was reached and no one was a pronounced evangelist for the replacement of the English system with the metric system. The metric system has been offered as a solution to our measurement problems several times in the past and has again aroused a great deal of interest. One reason is that the British Association for the Advancement of Science says that their inch-pound system, which became identical with ours as a result of a recent conference of six English-speaking nations*, is outmoded. They are currently conducting an inquiry to learn how much it would cost to make the change as opposed to how much it would cost not to make the change. The cost of making the change will be much easier to determine than the cost of not making the change, since the latter requires a look into the future and a prophetic judgment to arrive at the values derived from the change.

Although the English system of inches and pounds is far older than the metric system, the metric system offers the decimal with the advantage of intercomparison of length, mass and capacity. Too, the metric system is used by many nations and the number is growing as nations presently awakening to technological development have either adopted the metric system or are considering its adoption. The latter is of concern to the English-speaking countries because we export technology and its products. There is some difficulty attached to the export of goods that must satisfy one system of units when the domestic system of manufacture is different. Like the British, we are interested in the matter of costs, the maintenance and growth of foreign markets which are going metric and, finally, the evolution of an advantageous system.

At the meeting in Washington, one could be confused by the discussions since authorities from different segments of our society reported differing attitudes. In general though, hard goods manufacturing is opposed to a change since nearly the whole of our productive capacity is based on inches and pounds and to change would incur enormous cost. Tradesmen are more receptive to change and some domestic trade is adopting the metric system; the pharmaceutical and chemical fields are examples. In research, the metric system is almost universally accepted.

Since nature is agriculture's principal manufacturer, a large part of agriculture is trade. Nature manufactures to no human system of measurements, thus changes can be made in agricultural measurements much easier than for other segments of the economy that require production facilities.

At the meeting in Washington, Harry C. Trelogan of the Agricultural Marketing Service, USDA, reported on the situation in agriculture. His paper entitled NEEDS FOR STANDARDIZATION IN AGRICULTURAL MEASUREMENTS should be read by everyone interested in agriculture. Agriculture and the English system of measurements have old age in common. There the similarity ends. Our agriculture is most satisfactory; our system of measures is not.

Mr. Trelogan posed a problem in bushels. "To help you visualize the kind of problems arising from a lack of common understanding and use of a bushel measure, let me cite illustrations from our domestic economy without indulging in any of the infinitely more difficult and more numerous troubles encountered in international trade. The Commodity Credit Corporation deals with literally billions of bushels of grain annually. Prices for purchases, sales and loans are usually quoted in bushels. On the West Coast, however, sales are consummated on the basis of short tons. Transportation costs are handled in terms of hundredweight. Storage costs are handled in terms of bushels. Since a 60-pound weight per bushel is recognized by the Federal Government and by all States, the problems of their numerous conversions are relatively simple in the case of wheat. Explanations become a bit sticky, however, when a general account-

(Continued on page 154)

EDITOR'S NOTE: Mark E. Singley, professor of agricultural engineering, Rutgers University, and ASAE representative on the Council of the American Association for the Advancement of Science, reports on discussions (concerning the world's systems of measurement) by Section M, Engineering, during the annual meeting of AAAS in Washington, D.C., December 1958.

*On December 31, 1958, the standard setting-laboratories of Australia, Canada, New Zealand, South Africa, the United Kingdom and the United States announced the adoption of a common standard for the inch and the pound.

An 80-hp crawler tractor pulling two large combines picking up and threshing wheat from the windrow — near Barnaul in the "new lands" of Siberia

Farm Mechanization in the Soviet

Walter M. Carleton
Member ASAE

Agricultural engineer reports on visit to USSR by six ASAE members to study status of Soviet farm mechanization

SIX ASAE members studying farm mechanization, visited the USSR for a 30-day period during August and September, 1958. Their visit was a part of a larger USA-USSR cultural and scientific exchange. The purpose was to study the present status of Soviet farm mechanization, the agricultural engineering research, and educational programs, and to evaluate the findings in terms of probable future progress. The group travelled between 8,000 and 10,000 miles starting from Moscow then travelling south to the Ukraine and on to the "new lands" in Siberia, about 1,000 miles east of the Ural Mountains.

The *training of engineers for agriculture* is receiving great emphasis in the Soviet because of the urgent need for increasing agricultural efficiency and expansion into new areas. There are seven technical institutes for training these engineers, the principal one, the Institute for Mechanization and Electrification of Agriculture, being located in Moscow. After two days of rather close scrutiny of the curriculum, textbooks, laboratory equipment, and research program, members of the group were of the opinion that the laboratories were well equipped for both teaching and research, much attention being given to the development of teaching aids. Laboratory equipment included modern electronic strain-gage instruments, engine dynamometers, and high-speed movie cameras.

There are two principal paths open to the person pursuing a technical education in the Soviet Union. In one plan the student first completes 10 years of grade and high school which is followed by five years of training in the engineering institute. In the second plan the student attends seven years of grade school, then four years of technician training in high school, after which he may be employed as a technician or he may go on for five years in the technical engineering institute. In either case the student is granted the "diploma" degree, corresponding approximately to the bachelor's degree in the United States. Outstanding students may be given the opportunity for an additional year of study leading to the "candidate" degree roughly equivalent to the master's degree in the United States. The doctor's degree may be earned by research and thesis.

Admittance to institute study is on the basis of competitive examinations. These appointments are highly prized, permitting the selection of only the best students. This selection process is reflected in the statement that approximately 95 percent of those who enter the institute complete the 5-year course. Additional students attain degrees via the correspondence route, spending perhaps two months each year in residence. Since most of the students are subsidized, their chief concern is maintaining a satisfactory academic record.

Direct comparison of the number of engineers going into agriculture each year in the USA and the USSR is not possible. It appears that all the Soviet agricultural engineers are trained in "Institutes for Farm Mechanization" while in the USA many mechanical and electrical engineers find their way into the farm equipment industry, in addition to agricultural engineers. One thing is certain — the Soviets are training more women engineers than is the USA — the number of women students in the institutes varying from perhaps 10 percent to as high as 50 percent. On several occasions women engineers were found to be in responsible positions. For example, a woman was engineer in charge of sugar beet machinery development at a research station, while another woman was director of a machine test station.

Farm mechanization research in the USSR is, of course, entirely carried out by government organizations, either All-Union government or by one of the several republics. In the vigorous attempts to increase food production, primary emphasis is being devoted to mechanization of field opera-

Paper prepared expressly for publication in AGRICULTURAL ENGINEERING.

The author — WALTER M. CARLETON — is assistant director, AERD, ARS, U.S. Department of Agriculture, Beltsville, Md.

ASAE members in the group which visited the USSR in addition to the author, included Karl D. Butler, Avco Mfg. Corp., Ithaca, N. Y.; Arthur W. Cooper, National Tillage Machinery Research Laboratory, USDA, Auburn, Ala.; Carl W. Hall, Michigan State University; Lloyd W. Hurlbut, University of Nebraska; and Wayne H. Worthington, John Deere Tractor Research and Development Center, Waterloo, Iowa. Notes and ideas from all members of the group have been liberally incorporated into this article.

Map showing route followed by the Farm Mechanization team in the USSR. The point farthest east was Barnaul located approximately 1000 miles east of the Ural Mountains into Siberia

tions, although an appreciable amount of effort is being given to farm structures and rural electrification research. Inasmuch as a Soils Exchange group also visited the USSR, our farm mechanization group did not give attention to the research in this area.

Quantitative comparison of farm machinery research with that in the United States would be difficult. However, the USSR laboratories were adequately staffed and well equipped with advanced instrumentation for precise measurements.

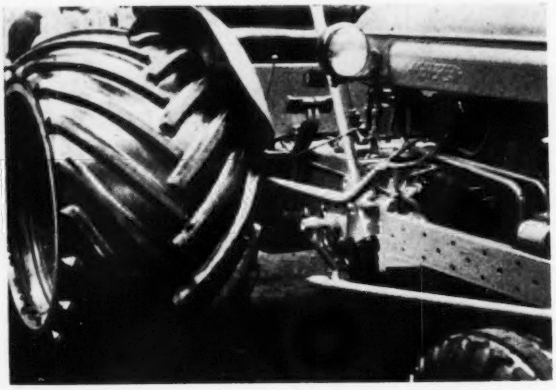
Tractor research included projects on implement mountings, engine efficiencies, electric motors, hydraulic systems, economic usage, and many others.

Other research included stress analysis, increased speed of operations, repair techniques and reconditioning of worn or broken parts, seed cleaning, tillage methods, and harvesting machines as well as many others commonly found in the United States. One very interesting project was concerned with the laboratory use of a plow bottom with a glass moldboard to determine feasibility for reducing wear and soil adhesion.

At one location only, the All-Russia Institute for Mechanization and Electrification in Rostov, did we find much work devoted to reduction of farmstead labor. At this institute vigorous attempts were being made to mechanize the handling and feeding of concentrates and/or silage to dairy cows and swine. However, the dairy barns on the collective and state farms have been somewhat standardized in a way that will make the adoption of automatic handling procedures difficult. It was stated that the loose-housing system of handling cattle was being investigated but only occasional evidence was visible to substantiate this claim.

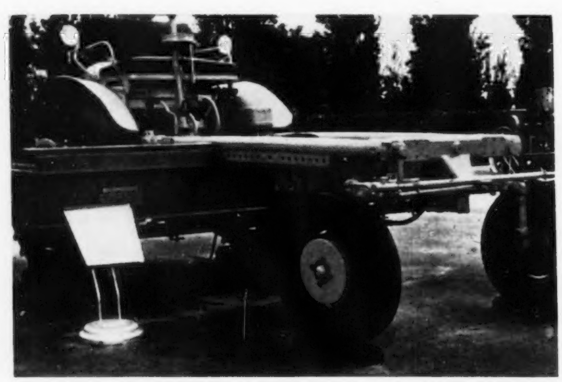
Farm electrification efforts are still largely devoted to problems of extending service to new areas. It was stated

(Above) A typical thatch-covered house on a Ukraine Collective farm. *(Left)* A fairly good log house located in the "new lands" area in Siberia. On numerous occasions it was noticed that the logs still carried numbers indicating pre-fabrication. Although log houses were common on farms in the new lands area, the typical farm house in the Ukraine was constructed of mud and straw blocks



An experimental tractor tire at the Minsk Tractor Plant. The tire was 840 mm wide and it was approximately one ft. from the rim to the outside of tire. The tire was inflated to about one-half atmosphere air pressure

An experimental single-row silage harvester on test at the All-Russian Institute for Farm Mechanization near Rostov. Short vertical synchronized cutting rolls seemed to do a very good job of silage preparation. The unit was PTO driven



(Above) A small self-propelled chassis on exhibit at the Ukraine Agricultural Exhibition. A wide variety of implements is available for use with this chassis. (Right) The track suspension system for a diesel 54-hp crawler tractor. The tracks were completely cast and no machine work of any kind was done on them before assembly

that 100 percent of the state farms and 60 percent of the collective farms were electrified, but these were often served by individual farm-operated generating stations rather than central-station high-line service. Electricity was almost universally furnished at 220 and 380 volts. "Electrified" farm in the USSR usually means power available, and extensively used, for operating threshing machines, grain cleaners, milking machines, etc. Very little electricity is utilized in the homes, the principal use being for light.

The All-Union Research Institute for Rural Electrification at Zaporozhe has three basic divisions of work; application of electricity to animal and crop production, power plants and distribution systems, and high frequency applications in agriculture. Some of the research includes work on electric tractors, automatic irrigation controls, light and heat in greenhouses, electric drying, and critical voltages and amperages for humans and livestock.

What is *the present status of farm mechanization* and farm machinery development in the USSR? In trying to arrive at a complete answer to this question one must consider numbers and ages of machines, stage of development, manufacturing facilities, and machinery research in progress. A complete answer is impossible but observations of each of these may lead to some educated guesses. Such was the procedure followed by our group.

Estimates indicate that there are about one million tractors, almost 100 percent diesel, in use on farms in the USSR today. Over half are crawlers, the most common crawler being equipped with an engine of slightly over 50 hp. Plans call for the percent of wheel tractors to be increased in the future. Tractors presently being manufactured appear to be rugged, heavy-duty units built according to the Soviet's own engineering design.

The presently-produced combines are generally of the self-propelled type, the ones produced at the plant at Rostov being equipped with hydraulic devices to raise and lower the reel, to change forward and cylinder speeds, and to assist in steering. They appeared to be rugged and modern in every respect. We were told that present production was about 40,000 per year at this one plant, although no verification is available for this figure.

Machinery development is generally carried out at the machine-building institutes or the research institutes previously discussed. However, testing and evaluation are carried out at the Machine Test Stations (MTS) where the prototype machines are subjected to more or less standard-

(Continued on page 153)

Criteria for the Design and Development of Farm Equipment

Karl D. Butler
Affiliate ASAE

Russell R. Raney
Member ASAE

Since parts used in the construction of farm machines, for the most part, fall within five functional systems, the authors use a five-point method for checking designs

FARM machinery is an extremely diverse family of equipment. Its members range from peg-tooth harrows to cotton pickers, from walking tools to mobile power plants, and from mowers to self-propelled threshing machines; so the family is as broad as the total range of tasks to be performed in agriculture in any climate or nation of the world. Under these circumstances, the criteria which we are seeking to establish will vary according to the viewpoint from which the machine is judged, from machine to machine, and, as we shall presently see, from element to element within a given machine. Our first problem, then, is one of taxonomy, in which we shall attempt to classify viewpoints, machines, and machine elements in such a way as to permit generalization about each individual topic of study and observation.

We suggest that there are three different viewpoints from which any farm machine may be considered, and that these are matters of *machine performance, economics,* and *personal human satisfaction.* We realize that these are not mutually exclusive areas, but it seems convenient, for the sake of intelligent discussion, to make this initial separation of the *kinds* of problems with which we ought to deal.

I. MACHINE PERFORMANCE

Broadly speaking, the function of any piece of farm equipment is to perform some agricultural task, especially one concerned with the handling or processing of such materials as soils, chemicals, seeds and crops. The distinction of machines by agricultural task is the usual one made in our everyday terminology since it distinguishes tillage tools from harvesting machines, and seeding machines from tractors or wagons; but this is not very helpful in finding like elements in various machines, about which to make general statements. But if we go to make a simple inspection of any piece of farm equipment, we can see that there are many parts which are not at all related to the agricultural task to be performed, and which, by their common appearance in many kinds of farm equipment, suggest that classification by some other scheme would be more helpful. We are referring, of course, to the numerous sprockets, gears, bearings, shafts, frame members, control levers, shields, etc., which never come in contact with the agricultural material. From the viewpoint of machine performance, they are no less important than those moving elements and constraining surfaces which are directly involved in the agricultural task, so it should be clear that the *material processing system* is only one of several *systems* of parts present in every piece of farm equipment. We shall be on the track of a better understanding of function if we attempt a classification of the other *systems,* and our classification will be complete when we are able to assign each and every part of a given machine to at least one of these *systems.*

We believe that any part in any piece of farm equipment may be classified as belonging to at least one of five functional systems: 1. a material processing system, 2. a power transmission system, 3. a structural system, 4. a control system, and 5. a protection system. With the aid of this functional division, we are now able to make some general statements about each which we believe to be valid for any piece of farm equipment.

Material Processing System

When we think of the whole family of farm machinery, one of its most impressive characteristics is the diversity of elements exhibited in the material processing system. Each agricultural task appears to have generated a different set of mechanical relationships in the finished machine, and, even for the same task, different makers appear to be able to accomplish similar results with widely varying arrangements of the processing parts. On the other hand, if we were to analyze all of the agricultural tasks, we would have to conclude that, in principle, there are only a few fundamental processes being performed in even the most complex machinery. We would like to suggest that the agricultural systems of all farm equipment are composed of one or more of the following eight general classes of processing units:

(a) Cutters
(b) Conveyors
(c) Separators
(d) Reducers (in the sense of particle size reduction)
(e) Compressors
(f) Quantifiers
(g) Binders
(h) Containers

A few words of explanation about each of these classes will serve to illustrate our meaning.

Cutters of some kind are found in almost every piece of farm equipment. From the plow coulter and the disk-harrow blade through to the reciprocating mower knife and the rotating cutterhead of the forage harvester, we can

The authors — KARL D. BUTLER and RUSSELL R. RANEY — are, respectively farm counselor, Avco Mfg. Corp. and director of engineering, New Idea Division, Avco Mfg. Corp., Coldwater, Ohio.

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readily see that cutting devices may take a wide variety of forms and shapes depending on the particular material to be handled and the required method of delivery.

Conveyors are no less numerous and take possibly an even greater variety of forms than do *cutters*. Manure-spreader aprons and grain-tank unloading augers are obvious examples, but it should be noticed that material-handling fans are also *conveyors* in a very real sense. When the function of the unit is simply to move material from one place to another without causing a change in the basic structure of the material, then we may class it as a *conveyor*.

Separators are closely allied to *conveyors* in that it is scarcely possible to segregate one kind of material from another without moving one in the process, but we think the distinction is easily drawn. The straw walker in a threshing machine certainly performs a *conveyor* function in moving straw to the rear, but the particular function which gives rise to the particular action and configuration of a straw walker is the desire to shake out any kernels of grain which remain in the straw after it leaves the threshing cylinder. A cotton-picker spindle *separates* cotton locks from the bolls of the plant, corn-picker snapping rolls *separate* the ears from the stalk, and husking rolls *separate* the husks from the ear. Diverse as these mechanisms appear to be, they all perform the same kind of job and in every case depend upon some contrasting physical characteristics of the materials to be separated for the success of their action. In fact, of the eight classes of processing units, *separators* are probably the most intimately associated with the agricultural materials and hence take forms which may not be found in any other family of machinery at all.

Reducers constitute a relatively narrow class made up of grinders, flails and crushers. Again, the physical character of the material pretty well determines the nature of the *reducer* employed. For example, a hammer mill, which is really an impact *reducer*, works better on dense, brittle materials such as shelled corn than on light, resilient materials such as corn cobs and corks.

Compressors are perhaps an even narrower class than *reducers*, since the familiar forms are basically tapered chambers through which the material is forced by power exerted through a screw or plunger.

The remaining three classes—*quantifiers*, *binders* and *containers*—are probably not as intimately related to the agricultural materials as are *compressors* or *separators* but they are still too closely associated to ignore the material entirely. If we think of a *quantifier* as a metering device, it must somehow be in connection with the material being measured, and the familiar star wheel feed in a fertilizer distributor is a good example. A corn-planting mechanism is another kind of *quantifier* which meters out so many kernels for a given amount of ground travel and may even be required to meter particular numbers of kernels at particular ground distances.

Binders are a class employing rather specialized techniques for handling tying strands such as wire or twine, and while mainly mechanical in operation, no one has yet succeeded in completely isolating one of these devices from the physical character of the material being bound.

Containers might almost be thought of as too simple to merit much attention since they are mainly wagon boxes, grain tanks, fuel tanks, fertilizer hoppers and the like. On the other hand, getting some materials to flow out of the *container* satisfactorily can be an exasperating task and some familiarity with the nature of thixotropic materials may save many tedious hours in the field.

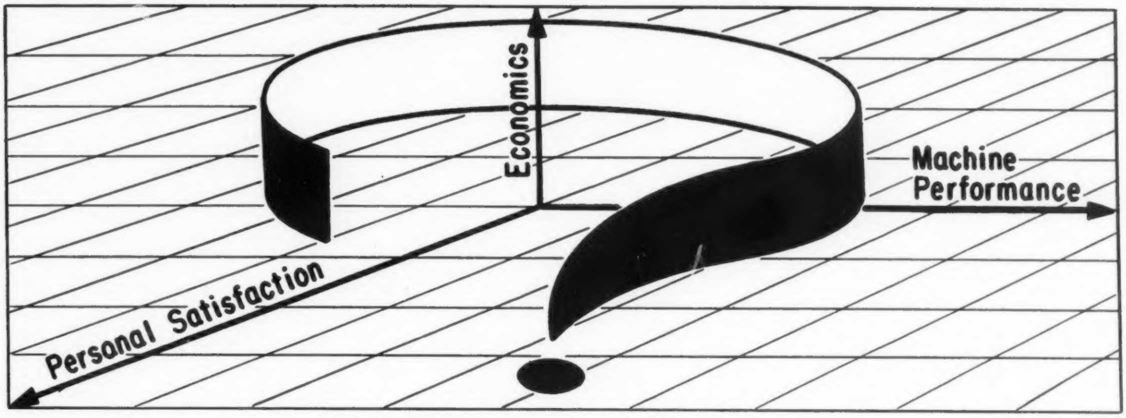
This is not intended to be an exhaustive catalog of all of the known processing devices, but we do believe it to be complete with respect to principle, and the processing system of any familiar machine should be susceptible to analysis on the basis of these principles. A corn picker, for example, is composed of a first *separator* (for separating the ears from the stalk), a first *conveyor* (for moving the ears to the husking bed), a second *separator* (for removing the husks from the ears), and a second *conveyor* (for elevating the husked ears to a point where they may be dropped into a trailing wagon). Highly ingenious pieces of equipment may combine several processes into one element as in the case of a plowshare which is at the same time a *cutter*, a *reducer*, and a *conveyor* (in moving and inverting the furrow slice to one side).

Insofar as criteria are concerned, about the only thing to be mentioned is the obvious requirement that the processing system must work, and under a variety of field conditions. It is also well-known that, in actual practice, scarcely any processing system works perfectly, but this does not necessarily mean that the job is unacceptable. A corn-picker, for example, may remove only 95 percent of the corn from a given field, but the alternatives, or the methods necessary to 100 percent removal may seem so far-fetched by comparison, as to seem ridiculous. A field could be harvested 100 percent by manual labor, or again, a machine might be contrived which would pick up all loose ears from the ground in addition to snapping ears from the stalks, but either of these approaches is likely to make the marginal cost of harvesting the last 5 percent exceedingly great, so that, in the long run, 95 percent harvesting would be considered satisfactory. This, of course, is an economic consideration, but it is also a challenge to engineers to devise a more efficient corn-harvesting machine at little or no change in complexity.

Criteria for the material processing system are, therefore, relative, and cannot be completely stated without reference to economic as well as machine performance considerations.

Power Transmission System

The consideration of the power train naturally requires some knowledge or assumption about how much power is to be delivered and at what points in the agricultural system. Experience or history may show only that a particular size of shaft or belt or gear is necessary at the final point of power input, but this is sufficient ground on which to proportion all of the other elements in the power train accordingly, and so achieve a balanced design. Shafts and other elements moving at tractor power take-off speed or higher ought to be designed to the endurance limit — that is to say, the maximum stress level should not exceed the value indicated as infinite life on the S-N (stress-frequency) curve for the material in question. After all, it takes only 100 hr, at the rate of 540 cycles per minute, to reach a total of 3,240,000 cycles and this may easily mark the finite life of common steels at stresses beyond the endurance limit. For slower moving shafts, rigidity becomes the more important factor and fatigue life recedes into the background as the potential number of stress cycles shrinks below the million mark. For gear sets, the same general considerations apply but with the additional factor of wear to be



A 3-dimensional question associated with machine design

taken into account. Enclosing a gear set naturally reduces wear considerably even if the enclosure is only dirtproof rather than oiltight.

In this scheme of things, bearings, too, are a part of the power transmission system, since the loadings which lead to their selection are taken directly from the power transmission considerations whether through shafts, gears, belts or chains. Again, the choice of governing factors—fatigue life or wear—is based chiefly on the speed range and the expected hours of use. It is debatable whether to consider lubrication as part of the protection system or part of the power transmission system. To us, it seems more natural to consider this problem simultaneously with the bearings, since bearing life cannot be assured without taking the lubrication into account.

This, of course, only hints at the technical criteria which may be employed in connection with the power-transmission system, but should serve to illustrate the general criterion that no mechanical failures ought to be either tolerated or anticipated in power-transmission elements. Difficult field conditions may overload or block the power transmission system, but this only points up the need for protective devices which will be mentioned subsequently. Power-train failures are most serious since the entire operation must be halted until a repair can be made. There is here no question of degree—the mechanism either works effectively or not at all.

Structural System

The structural system has several tasks to perform. First of all, the agricultural system, especially the constraining surfaces, has to be maintained and the weight of the parts themselves supported and transferred to the earth either through a base frame or through a wheel-and-axle structure, if we are considering a mobile piece of equipment. Transporting mobile equipment over rough terrain usually imposes loads of 2 to 3 G's (force of gravity) or more on the supporting members so this is typically a problem in dynamics rather than statics. Add to this the loads imposed by the bearing supports of the power-transmission system, the inertia effects of reciprocating members or hidden flywheels, and the structural problem begins to assume unmanageable proportions. Usually the best that we can do on a totally new structure is to locate the right kind of members in the proper locations and test our estimate of the stress magnitude later by means of strain gages on the working model. If we have a good grasp of the system to be employed and the direction the forces will take, it will be easy enough to adjust the size to suit the observed readings.

Two things stand out in our experience with structures—one is flexibility and the other is the importance of good end connections. Most farm machinery is extremely rubbery by comparison, let us say, to machine tools; there is no real need for milling machine accuracy in a manure spreader, for example. As a matter of fact, many pieces of farm equipment are benefited by the ability to accommodate ground irregularities by twisting or distorting the frame rather than by articulation of the wheel and axle carriage. On the other hand, we cannot tolerate such a high degree of flexibility in those portions of the frame which maintain gear mesh, align sprockets, or secure the relationship of working parts, such as cylinder to concave in a threshing system. Our thought processes are best served if we think of farm implement structures as *islands of rigidity in a sea of flexibility*. This is, at least, an approach to reality and it is also the clue to the proper design of end connections. If we decide in advance which members are to be flexible and design the end connections accordingly, then we shall be able to avoid the majority of petty annoyances.

Again we are only hinting at the range of technical problems to be recognized and solved in determining the structural system, but it should be noted that structural failures are just about as intolerable as failures of the power-transmission elements—the structure must live and continue to do its job under the most adverse conditions.

Control System

The control system includes all of the adjustments, clutching devices, lifting devices, etc., which are necessary to the practical operation and transport of the machine. Some of these controls must be remote, some must be made on the go, and others may be used to compensate for wear at longer intervals of time. Whatever the control, however, the overriding requirement is that it be convenient for a human being to understand and manipulate. The controls and adjustments are the portion of the machine with which the operator has the most intimate contact, and we have to broaden our outlook considerably in this area to achieve a satisfactory measure of simplicity which is the key to fool-proof operation.

Internally, controls and control systems may be extremely complicated, especially if they involve hydraulic or electronic systems. Such systems may become whole design projects in

themselves requiring specialist designers for their perfection and application to the whole machine. We mention them here only to illustrate the gamut which control devices may run and, whether simple or complex, they must be accounted for in conceiving the whole machine.

Protection System

Protection systems are of two kinds: those which protect the machine, and those which protect human beings against bodily injury in the operation of the machine.

The need for machine protection usually arises from the fact that field conditions are often so variable that the possibility of plugging, locking, or overstressing the power train becomes a statistical certainty. It is a known fact, for example, that there are rocks and stumps in some fields where plows may be used and some kind of disconnect system is practically mandatory in the hitch in order to avoid bent beams and distorted frames. Or, in a piece of power driven equipment, it is folly to proportion the power train to handle, say, 5 hp, and then drive it from a 25 hp source if there is any danger of plugging. The most common device for this situation is the familiar slip clutch with ratchet type, spring loaded jaws, or the more modern slip disc type of overload device which eliminates the axial trip hammer action. There seems to be a practical upper limit to the amount of power that can be dissipated through one of the slip devices, however, and for very high overload characteristics, a shear bolt or shear pin may be the better solution. Shear bolts must, of course, be replaced whenever a failure occurs, but against this disadvantage we may balance the feature that the shear strength of any probable bolt or pin material is much more reliable than the friction values on which the usual slip devices depend. Mechanical releases and torsional overload devices may take many forms and it is completely beyond the scope of this paper to enumerate them here.

The consideration of devices which protect human beings from bodily injury again involves us with a personal human factor as well as a technical problem. We say that farm machinery has to be fool-proof, but it is difficult for the engineer to cope with the imprudent operator who throws the shields away or who insists on unplugging a corn picker while the machinery is running. The ideal machine is one which performs so satisfactorily that there is neither the temptation nor the need for a person to risk contact with the moving parts, but such perfection is not readily achieved and there are still many unsolved safety problems in farm machinery.

We conclude this discussion of the criteria associated with the area of machine performance by noting again the fact that, just as there is a diversity of agricultural machinery, there is also a diversity of function among the parts which comprise a single machine. The criterion, or standard of judgment, is determined by the *kind of role played by a particular part,* and there is no overall standard which can be made to serve for the entire piece of equipment.

II. ECONOMICS

In the preceding section we were, in effect, answering the question: "What standards of design must we observe in developing a successful, working model of any desired piece of farm equipment?" In this section, which takes up the economic viewpoint, we will be answering the question: "How shall we measure the consequences of such a machine when it becomes available in a quantity sufficient to bring about a widespread change in agricultural practice?" This question prompts us to make two observations which may be thought of as digressions, but we hope will serve to improve the perspective as we move on to a direct discussion.

The first observation is that *some quantity* of machinery is necessary for it to have an impact on agriculture. Agriculture is coextensive with the land area, and it is not practical to consider the impact of a few machines of large industrial size or capacity simply because they would be too unwieldy to move about over the fields under cultivation. On the other hand, there is no advantage to be gained by performing an operation in a mobile, field-going piece of equipment when it could be performed more effectively in a larger unit off the farmed land area. As an example, the cotton picker must move through the field in order to gather the cotton, but the ginning machinery need not be taken to the field because it is easier to move the cotton to the gin. Furthermore, a few men can operate a relatively large ginning installation capable of servicing a large number of pickers, so that there is an economy of manpower as well as simplification of the fieldgoing units.

This brings us to the second observation which is, simply, that the major objective of farm machinery is to minimize the manual labor requirements. This may seem too obvious to merit much attention, but it does provide a clue to the economic yardstick we are seeking to establish. Furthermore, it should be noted that the effect on manpower is a common denominator which can be applied with equal validity to either a free-enterprise or a state-controlled economy. Our economic yardstick as applied to farm machinery may then be considered as universal and completely objective with respect to all circumstances of political philosophy and national culture.

In actual practice, there are instances of two kinds of comparisons which must be made. One is the comparison of the proposed machine with manual labor as already suggested, but, in an agricultural economy which is already largely mechanized, we must also be able to weigh the effect of the proposed machine against other machinery already in use. In this latter case, an economic advantage may be obtained by either of two paths: 1. the proposed machine may, by the application of more power, for example, enable one man to accomplish a given task at a faster pace, or 2. the proposed machine may, because of the ingenuity or simplicity of its construction, enable one man to accomplish the same task with a smaller, or less costly piece of equipment. Examples of both kinds may be cited, but the overwhelming trend in farm mechanization has been along the first path where increasingly powerful and more complex machinery has enabled one individual to accomplish larger and larger tasks. It should be noted that the trend to more powerful machinery does not result in a direct displacement of manual labor, but, instead, places the operators of smaller equipment on smaller plots at a disadvantage which ultimately compels them to retire from the agricultural scene or else to accept a lower standard of living.

It should now be clear that the economic criterion should take into account not only the size or complexity of the proposed machine but also its *rate of operation.* This means that the quantitative measure of a machine's effectiveness

can be expressed by a ratio between its *capacity*, or ability to do work, and its initial *cost*, whether measured in terms of money, or in terms of the material, labor, and capital equipment necessary to quantity production of the machine. The effectiveness of any machine may be so stated, and it then becomes possible to make an economic comparison among any group of machines doing like jobs on a simple quantitative basis as determined by the ratio of capacity to cost.

At this point we need to take a careful look at the meaning of capacity when used in the economic sense. Capacity is usually stated as a characteristic of the machine in steady operation as, for instance, bushels per hour, or acres per day, etc. However, these data do not usually include any reference to the human effort necessary to prepare the machine for use, or to maintain the working parts during the machine's useful life. True capacity, in the economic sense, must reckon with every minute of the time expended by the operator in hitching and unhitching, in lubricating, in refueling, in adjusting the machine to meet various field conditions, and in replacing or repairing damaged or worn parts from time to time. The maneuverability of the machine enters into this, too, since the negotiation of rough land, turning on headlands, etc., will add more or less to the total time of operation required to accomplish a given task. Viewed in this light, it is seen that the economic capacity of a machine may be greatly affected by refinements in the lubrication system, by rapid-acting hitches, by power-steering, by the quality of the bearings, or in numerous other ways which do not pertain to the main task of processing the soil or harvesting the crop. Only by taking these considerations into account is it possible to keep the human effort present in the economic viewpoint, and this, as we stated earlier, is the major economic objective of any piece of farm equipment.

A few words need to be added in respect to machine life. In the section on machine performance, machine life was used in the sense of mechanical endurance. This applies in the economic sense, too, since it determines the total life capacity of a given piece of equipment, but our economic viewpoint compels us to consider obsolescence as well. The rate of obsolescence is an unpredictable factor which becomes known only as a matter of history at some point in the future after today's offerings have been taken up. Today's jobs demand that something be done now, but it would seem imprudent to make a relatively large new investment for the sake of a small increase in effectiveness when present machinery and methods can be relied upon to produce satisfactory results.

III. PERSONAL HUMAN SATISFACTION

Up to this point we have dealt with our problems on an impersonal basis, and in those few instances where some reference has been made to a human operator, he has been regarded as a kind of robot, capable of doing certain menial tasks requiring some degree of skill, but without personality, ambition, ego, or human desires. In this closing section we shall risk a few observations in a much more nebulous area, and attempt to define those considerations which make for good personal relations between the operator, or owner, and the machine operation for which he is now responsible.

Three considerations which enter into any personal relationship with a machine are comfort, convenience, and safety. These are simple matters, but they are qualitative rather than quantitative, and so do not lend themselves to precise measurement as did the technical and economic considerations. A fourth consideartion—aesthetic response—is even more difficult to define, but it should be observed that this may have a strong bearing on the person's "pride of possession," in the philosophical sense, and so may make a substantial difference in his attitude toward the machine as a whole.

Comfort, convenience, and safety have economic as well as personal implications. A comfortable machine will not be as fatiguing to operate as an uncomfortable machine, for example, in which case the operator will not need as long or as many rest periods. A conveniently operated machine will allow for easier control and so permit a better quality of work to be performed. And in the same vein, a safe machine will minimize lost time due to accidents or carelessness. But beyond these effects on operator efficiency, it seems to us more important to point out the favorable psychological response which is generated in the attitude of the operator toward his work. We want the operators of this equipment to *like* their jobs and to take *pride* in their performances. And this, we contend, is accomplished not only by sound mechanical design and wise economic selection, but by paying especial attention to those elements of the machine with which the operator has the most intimate physical and mental contact.

Subconsciously, perhaps, the aesthetic response conditions a person's attitude toward a machine from the first moment he sets eyes on it. The outline, color, and texture of the machine can be made to suggest ruggedness, reliability, and to the operator who sits at the controls, a flattering sense of mastery over great power for the lucky person to whom it may be entrusted. The sounds and the "feel" of a machine play their part, too, and many rural citizens find that they feel themselves to be a real part of the jet-propelled age when they sit astride their throbbing engines, and feel the surge of power being converted into useful work all around them. And for those who are moved to reflection by these sensations, there must also be a sense of gratitude that their lives on the farm are not as hard as their fathers' as well as a sense of confidence that future generations of farmers will reap the benefits of new machine developments as yet unborn.

It is impossible to close a paper of this kind without paying tribute to the *knowledge* which underlies human effort in this or any other field, and, in a deeper sense, to reverence the Creator who has endowed us with the ability to think, to analyze, and to apply the gift of knowledge to the task of feeding and clothing mankind. There is no such thing as a self-made man. The process through which we are born into this world, and our individual capacities for creative work are phenomena which now lie beyond our control or comprehension. We know only that, in man, the fruit of creative work can be imparted, through knowlege, to all who care to read, listen, and act on the inspirations or "inventions" which result from such work. It is left for man only to choose between the constructive or destructive application of knowledge and in this we may realize a deeper measure of *human satisfaction* as we continue a truly constructive endeavor in applying knowledge toward the betterment of agriculture.

Solar Energy:

Present and Foreseeable Uses

Robert J. Pelletier

An analysis of the present status of solar energy utilization and its probable potential

MODERN technology, in particular modern American technology, is consuming energy at an ever increasing rate. During the past 150 years, a definition of technological progress might have been "the coupling of new ideas to more power." It is coming to be realized, however, that the sources of energy, as we are familiar with them, are limited to a finite and decreasing reserve of fossil carbon fuels: oil, gas, and the various forms of coal. The climbing curve of demand for these fuels will eventually be leveled and turned down by the decreasing supply curve. The location of this point of maximum production in the future is variously estimated to be from 50 to 100 years from now, depending on the estimator and his sources of information. The increase of population for the world as a whole and the desire on the part of the most underdeveloped areas to adopt modern technology have hastened the trend.

The adoption of nuclear fuels and their substitution for fossil fuels will help the situation considerably since nuclear fuels are in good supply according to recent estimates. However, the use of atomic fission to produce power raises problems of protection and waste disposal which will probably limit nuclear power to large central plants relatively close to urban areas so that the power generated can be consumed most efficiently.

In any case, the direction of technological development will have to change somewhat to include the search for devices which use less energy or are able to operate on current energy income, *i.e.*, sunlight, directly or in its indirect forms. The magnitude of this changeover can be estimated by realizing that at present only about 15 percent of the energy consumed is from sources other than fossil fuels. Water power, burning vegetation and, in a few instances, wind power are able to compete with coal, oil, and gas in certain areas, and constitute the only attempt to live on income rather than deficit financing in the energy sense.

For the United States, the world's largest energy consumer (annual equivalent of 9 tons of coal for every man, woman and child), the biggest share goes to industry. Second and nearly as large, however, is the use of fuel for space heating. The degradation of high level energy from burning fuels to provide low level energy for space heating seems particularly wasteful and inefficient.

This last named was one of the chief reasons for beginning research into the use of solar energy for space heating at the Massachusetts Institute of Technology when funds were provided by Dr. Godfrey L. Cabot in 1938 with the express condition that they be used to further research into the direct utilization of solar energy. Work was done and valuable contributions made in several other areas of energy conversion research: blocking layer photocells, photosynthesis and other uses of sunlight, such as in thermoelectricity. Work is presently being done on chemical conversion processes, notably the decomposition of water into oxygen and hydrogen by means of sunlight and a catalyst, a reaction which has been detected but for which yields are as yet minute. Recently there have even been serious and ingenious proposals to use solar energy for the propulsion of interplanetary space ships. The remainder of this discussion, however, will concern itself with the problem of collection of solar energy in the form of heat, sensible and/or latent.

Just outside the earth's atmosphere, the sun maintains a continuous energy bombardment of 1.94 cal per sq cm per min (429 Btu per sq ft per hr or about 1 kw per sq yd) on a plane normal to the oncoming rays. By the time the energy reaches the surface (sea level), absorption and scattering of the various atmospheric components have taken their toll and the total has been reduced to a maximum of about 320 Btu per sq ft per hr. In addition, the plane is now subject to the rotation of the earth which limits the exposure time to only one-half day in general (varying with latitude and season) plus the effects of clouds, smoke, dust, etc. Altitude and latitude both affect the amount of radiation received, with altitude probably the more significant in the temperate zone.

The distribution of sunshine is fully as important as the amount received. Certain areas are particularly unfortunate in having their periods of coldest weather coincide with long periods of cloudy weather. The Great Lakes region in the United States is such an area. Throughout most of the country, however, the weather pattern is more favorable. The Boston area, for example, which does not list copious sunshine among its greatest attractions, has recorded that 90 percent of its cloudy periods are of less than 72-hr duration during January, the most severe heating month. This type of information is especially important when the amount of storage capacity is to be decided.

The amount of useful energy that can be had from a given device depends first upon the area of the device being irradiated and, secondly, upon the efficiency of the device. Thus, if sunlight falling at a density of a/b Btu per sq ft is intercepted by a collecting device having c sq ft of surface and an efficiency of x percent, then the amount of useful energy that could be collected would be $(a/b)\ (c)\ (x/100)$ Btu per hr.

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The author—ROBERT J. PELLETIER—is research associate, department of civil and sanitary engineering, Massachusetts Institute of Technology, Cambridge.

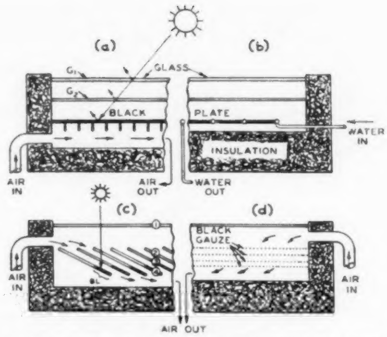

Fig. 1 Four types of flat plate collector that have been used successfully

Collection Devices

The types of devices used to collect radiation can be divided into two basic categories: concentrating devices and flat plate collectors. Concentrating devices utilize lenses or mirrors to achieve high temperatures on a small area, while flat plate collectors produce much lower temperatures over a wider area. Except for specialized uses such as steam generation or where very high temperatures are required, the flat plate collector is the more efficient (useful efficiencies of 35 to 50 percent of incident radiation can be expected) and the most frequently proposed method of collecting thermal energy at low to medium temperatures.

The flat plate collector is an ideal type of device in that it contains no moving parts, does need elaborate companion machinery to track the sun, needs little or no maintenance, and is capable of very high efficiencies when compared to other thermodynamic devices. In general terms, the flat plate collector consists of three essential parts:

(a) A blackened surface for absorbing radiation, or something that appears to be a black surface when viewed from the same angle as the sun.

(b) A fluid, either a liquid or a gas, to carry off the absorbed energy in the form of heat.

(c) Some means of reducing the backward heat losses; one or more layers of transparent material which will pass incoming short-wave radiation and be opaque to long-wave outgoing radiation, or a surface that absorbs strongly incoming radiation but emits very small amounts of outgoing radiation.

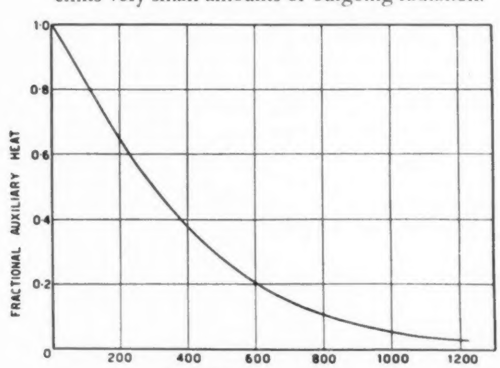

Fig. 2 Percentage of heating is not directly proportional to collector area because of undependability of sunshine and variability of required heat

Fig. 1 shows four types of flat plate collector that have been used successfully.

The heat absorbing surface can assume various forms: the black painted lowest portion of each of a series of overlapping glass plates, several layers of black gauze, a black painted metal plate, finned on the reverse side for additional heat transfer surface, or a blackened metal plate to which tubes have been attached. The first three of these plates were designed to utilize air as the collecting medium and the last type uses water or some other liquid.

In each case the absorbing surface has been covered with at least two layers of glass which has the property along with most other transparent materials that it transmits almost all radiation from wavelength 0.3 to 2.8 microns (comprising more than 98 percent of the energy content of sunlight) and is completely opaque to wavelengths longer than about 5 microns (the heated plate emits radiation longer than about 8 microns, thus cannot lose heat by radiation passing directly through the glass).

The efficiency of the collector depends on the amount of radiation reaching the collecting surface, the temperature of operation, and the degree of insulation of the collecting surface. The temperature of operation is controlled by the use to which the collected energy is to be put. Although the placing of transparent layers over the collecting surface reduces somewhat the amount of energy reaching the plate, the insulating effect with respect to backward losses more than compensates for this effect. The optimum number of transparent layers depends on the difference between collecting temperature and the outside air temperature. For a temperature difference of about 100 F, two transparent layers are optimum. If the collector is being used to make steam, three or four layers become necessary. Thus, as the collection temperatures becomes higher, the efficiency goes down and the cost of construction goes up until eventually concentrating devices become more economical. The recent development of "differential black" surfaces (surfaces which appear black to sunlight and hence absorb upwards of 90 percent of the radiation, but appear shiny to long-wave heat radiation from the plate and so emit only about 10 percent or less than a conventional black surface) gives promise of extending the range of collecting temperatures and lowering the construction costs appreciably by eliminating layers of glass. Another method of increasing the output and lowering costs is to collect energy at lower temperatures and raise the temperatures by means of a heat pump. This system has the advantage of increasing the efficiency of both devices, since the efficiency of the heat pump goes up rapidly when the temperature of the heat source is raised above 50°.

Storage of Energy

Since the sun shines only an average of 12 hr a day, some means must be found to store collected energy from the hours when it is available until it is most needed. The two chief methods used are storage of energy as sensible heat in some high heat capacity material such as water or crushed rock, or as the heat of fusion of some salt or other material having a convenient melting temperature. There are techniques available for computing the amount of storage required for a given house, assuming a given amount of heat required, and utilizing weather bureau radiation data. For a moderately severe New England climate and weather

pattern similar to the Boston area, storage for three days is judged to be the most that could be considered economical. Heat capacity storage in water takes the space equivalent of an average size coal bin, while gravel storage requires several times that volume. Salt storage, on the other hand, requires only about one-third to one-fifth the space required by water but presents other difficulties. The problems of supercooling, stratification, incongruent phases, and the necessity of stirring the salt solutions have tended to keep studies of heat of fusion materials in the laboratory for most, though not all, investigators. It should be realized also that even a manifold increase in storage capacity will not entirely eliminate the need for auxiliary heating in many areas. (See Fig. 2 which assumes very large storage capacity.)

Heating System Design

Once collector output has been determined, it becomes possible to design a heating system around this basic heat collection mechanism. Weather bureau data on amount and distribution of sunshine during the heating season are essential to compute accurately the size of the collector and associated storage. Utilizing these data, it is possible to subject them to methods of analysis which have been developed (3) and arrive at an amount of useful heat which will be collected in an average year. When compared to conventional fuels, this heat will have certain monetary values, depending on the type of fuel and the geographic location. When the area of the collector is divided by the annual value of heat collected, the earning power of each square foot of collector is determined. Since the amount of heat required to heat the space for which the system is being designed is a finite amount, there is a total annual fuel bill to compare to the annual charges on any substitute system. Because of the undependability of sunshine and the variability of required heat with time of year, the percentage of heating is not directly proportional to the collector area; and, in fact, if the design criteria of full comfort conditions is to be maintained at all times, then the amount of collector varies according to a curve (see Fig. 2). The significance of this curve is apparent from observation. Although 50 percent of the annual heating load can be handled by a collector of x sq ft and doubling the area increases the heating to 80 percent, it should be noted that even an area of $4x$ sq ft does not handle 100 percent of the load. From this it can be seen that the use factor on a very large collector must be very small since the full output is used only a very small percent of the time.

This type of calculation can be carried even further, and the optimum amount of collector for a given application determined. If we assume that only the fuel savings can be used to amortize the added cost of the solar system, usually a good assumption since an auxiliary system will be required in most instances, then a curve of the type shown in Fig. 3 can be drawn. The cost of conventional fuel is gradually replaced by energy from the collector system, the amount of supplementary fuel depending on the amount of collector used. An amortization period for the collector system is assumed and the annual charges on each square foot are added to total cost of fuel needed with a collector of the area assumed. The total cost curve will descend, level off,

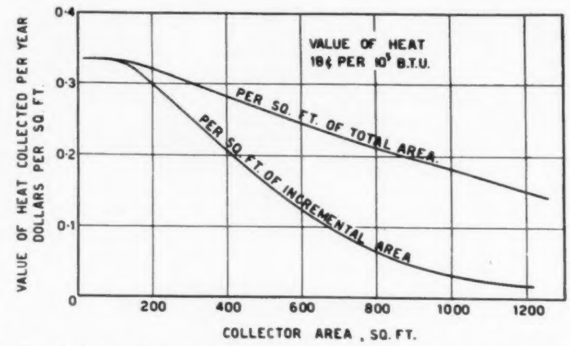

Fig. 3 Value of heat collected per year based on assumption that only fuel savings are used to amortize added cost of solar system

and finally turn upward (See Fig. 4), due to the decreased use factor for very large collectors. The low point of the curve is the point of optimum collector area for the case under consideration. Whether or not this low point falls below the level of fuel cost alone depends on the cost of fuel as compared to the cost of collector. Calculations of this type help to explain why solar heating is not expected to take over completely in the most favorable regions such as the Southwest since these are also cheap fuel areas as well (natural gas). One can also see that as fuels become higher in cost as they become more scarce and as collector costs go down the situation will change radically.

Present Utilization

A number of solar heating systems and solar heated buildings have been built in the past 20 years, three at Massachusetts Institute of Technology alone. The results of these experiments have been used to develop dependable design criteria. The chief problem presently confronting anyone wishing to construct a solar heated building is that of collector cost. No industrial organization exists for the efficient production of such systems. Collector designs which would potentially be cheap to produce in quantity, utilizing techniques of mass production, are too expensive when fabricated as isolated units to appear attractive. One is faced with a chicken or egg situation in which a manufacturer hesitates to produce anything in quantity without having a demonstratably large market, while the high cost

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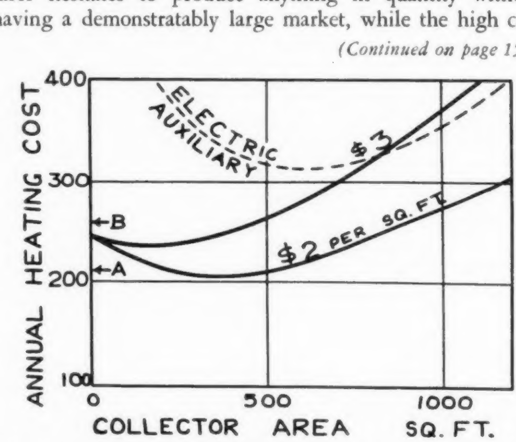

Fig. 4 Annual heating cost descends, levels off and finally turns upward because of decreased use factor with increased size collector

River Basin Planning as a Fundamental Concept

Howard L. Cook

Beginning with the First Conservation Crusade, over 50 years ago, the concept of comprehensive and unified river basin plans has gained wide acceptance and appears likely to play a major role in the future of resource development throughout the United States

DURING the past half-century those most concerned with the nation's natural resources have given a great deal of thought to the problem of how to make the most of those resources. One of the most important results of this thinking has been the development of the idea that within each major river basin, or other appropriate region, all resource development activities should be guided by a comprehensive and unified long-range plan. This idea is the basic concept with which this paper will be concerned.

This basic concept comprehends, of course, the earlier and more limited concept of the multiple-purpose project. It assumes, moreover, that the ultimate goal of the nation is to develop, utilize and conserve its natural resources in such a way that they will make a maximum possible contribution to the wealth of the nation as a whole, and to the welfare of its citizens.

Today a majority of those considered expert in the resources field subscribe to this concept. But like most basic concepts, this one has a long and interesting history. A brief outline of that history will provide a good deal of perspective for those who wish to understand where we are today, and how we got there.

History of the Concept

The concept of the comprehensive and unified river basin plan became a factor in American political life as a result of what is often called the "First Conservation Crusade." This crusade had a vigorous leader in President Theodore Roosevelt, and a "brain trust" headed by that great conservationist, Gifford Pinchot. Pinchot and the group of dedicated public servants he gathered about him were far ahead of their time in breadth of vision. In fact, one of the best statements of the basic concept we are here considering appears in the letter, dated February 26, 1908, with which President Roosevelt transmitted to the Congress the preliminary report of the Inland Waterways Commission. In this letter he said:

> "The report rests throughout on the fundamental conception that every waterway should be made to serve the people as largely and in as many different ways as possible. It is poor business to develop a river for navigation in such a way as to prevent its use for power, when by a little foresight it could be made to serve both purposes. We cannot afford needlessly to sacrifice power to irrigation, or irrigation to domestic water supply, when by taking thought we may have all three. Every stream should be used to the utmost. No stream can be so used unless such use is planned for in advance. When such plans are made we shall find that, instead of interfering, one use can often be made to assist another. Each river system, from its headwaters in the forest to its mouth on the coast, is a single unit and should be treated as such. Navigation of the lower reaches of a stream cannot be fully developed without the control of floods and low waters by storage and drainage. Navigable channels are directly concerned with the production of source waters and with soil erosion, which takes the materials for bars and shoals from the richest portions of our farms. The uses of a stream for domestic and municipal water supply, for power, and in many cases for irrigation, must also be taken into full account."

At the time President Roosevelt sent forward this cogent statement the architects of the crusade might well have thought that the basic concept behind it needed only to be stated to secure immediate acceptance, and to be put into effect. Undoubtedly they would have found it hard to believe had they been told that a half-century later most of the nation would still be without the comprehensive and coordinated river basin plans envisioned in that statement.

The leaders of the crusade drove hard for public acceptance of the concept expressed by the President. The National Conservation Commission in its 1909 report urged that river basin plans include:

> "All the uses of water and benefits to be derived from their control, including the clarification of the water and abatement of floods for the benefit of navigation, the extension of irrigation, the development and application of power, the prevention of soil wash, the purification of streams for water supply, and the drainage and utilization of the waters from swamps and overflow lands; . . ."*

And the Commission had every reason for believing that its views were widely accepted even at that time, for at the National Conservation Conference in 1909, delegates from the states, including many governors, came out strongly for river basin development on a broad and multiple-purpose basis.

In the Congress that great champion of conservation, and father of the federal reclamation program, Senator Newlands of Nevada, became the spearhead of the conservation crusade. Time after time he sought legislative implementation of the basic concept of river basin development.

Strangely enough, few today realize that Senator Newlands finally succeeded in securing the enactment of legislation embodying the concept of broad and coordinated basin plans. His 1917 amendment to the General Dam Act authorized the establishment of a commission: ". . . to bring

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The author — HOWARD L. COOK — is engineer, Office of the Chief of Engineers, Corps of Engineers, Department of the Army.

*Volume I, page 47, Senate Document 676, 60th Congress, 2nd Session.

into coordination and cooperation the engineering, scientific and constructive services, bureaus, boards, and commissions of . . . the Federal Government . . . with a view to uniting such services in investigating . . . questions relating to the development, improvement, regulation and control of . . . navigation . . . irrigation, drainage, forestry, and swamp land reclamation, clarification of streams, regulation of flow, control of floods, utilization of water power, prevention of soil erosion and waste, storage and conservation of water for agricultural, industrial, municipal, and domestic uses . . . and to formulate . . . a comprehensive plan or plans for the development of waterways and the water resources of the United States . . ." If you think this language has a modern ring—you are right. Many of the most advanced legislative proposals of the last decade contain very similar language.

This was the legislative high water mark of the conservation crusade. The United States became involved in the first World War, and no funds were appropriated to implement the legislation. The tide had begun to ebb. In 1920 the Newlands legislation was repealed by the Federal Water Power Act. Little was to be heard of the conservation doctrines of Theodore Roosevelt and Gifford Pinchot until the so-called "Second Conservation Crusade" of the 1930's.

But the ideas implanted by the crusade did not die. They had their influence on legislation and on the administration of federal water programs. They were reflected, to a limited degree, in the Federal Water Power Act itself, and in a particularly important way in the act of January 21, 1927, which authorized the U.S. Army Corps of Engineers to undertake the so-called "308 Surveys" for the purpose of formulating general plans for the multiple-purpose development of the rivers of the United States. The "308" reports provided a basis for many of the projects subsequently carried out under the Flood Control Acts, and in a number of major basins they still serve as the principal guides for multiple-purpose development.

In 1933 another Roosevelt administered what proved to be a strong stimulant to the concept of the comprehensive basin plan. At the behest of President F. D. Roosevelt the Congress authorized the first actual experiment in putting into effect the basic idea behind Senator Newlands' 1917 legislation. The Tennessee Valley Authority was established and given broad authority to plan and carry out a program for the development of the Tennessee Basin.

But other powerful influences were also brought into action. One of the most effective of these was the National Resources Planning Board with its far-flung system of committees; a system which proved to be an extremely effective mechanism for disseminating and nurturing the basic ideas which have come to dominate modern thinking about resource development. The NRPB was eventually abolished, but the good that it had done was not all interred with its bones, and among the more important results of its brief life was the impetus it gave to the basic concept of comprehensive river basin plans.

These, and other developments set the stage for the broad consideration given Federal resource policies and programs in 1950 by the bi-partisan President's Water Resources Policy Commission. Among other things this Commission said:

> "The Nation should have comprehensive, multiple-purpose, and coordinated plans for . . . regions . . .: Each of the plans should be carefully adapted to the potentialities of the region as well as to regional needs and should include local and State as well as Federal undertakings. Such a plan need not initially be in complete detail, but it should constitute a framework into which can be fitted, in proper relation to all other activities, the projects and programs as they are further developed."

It also said:

> "Planning for water resources cannot be dissociated from planning for all resources. Nor can it be dissociated from those fields of economic activity which give rise to the needs to be met by water developments. This leads to the further conclusion that water developments should be planned as integral parts of basin programs."

and;

> "Planning should be approached with the multiple-purpose concept and with the aim of maximum net benefits based on full consideration of alternative plans for meeting existing and anticipated needs . . . full weight must be given to watershed management, municipal and industrial water supply, hydroelectric power, pollution abatement, as well as to flood control, irrigation, and navigation, to the extent of their importance in the particular region."†

That these words truly reflect the convictions of nearly all those intimately concerned with resource development and use is indicated by the policy proposals formulated by a panel of experts established by the Engineers Joint Council. In a 1951 report this panel gave strong support to comprehensive basin plans. Another indicator of the degree to which the basic concept has entrenched itself, both within and outside of federal circles, was afforded by the Mid-Century Conference on Resources for the Future, in the course of which it became evident that it has strong support in all walks of life.‡

After some hesitation at the outset the Eisenhower Administration threw its full support to resource development through comprehensive basin programs. It was encouraged to do so by the Second Hoover Commission which—basing its recommendations upon the monumental report of its task force on Water Resources and Power—came out strongly in 1955 for coordination of federal programs at the river-basin level. But the main basis for the policy recommendations of the present administration is the report of the Presidential Advisory Committee on Water Resources Policy which was sent to the Congress by the President with his indorsement on January 17, 1956.

It now appears that the concept of the comprehensive and coordinated basin plan has so well established itself that little active opposition is likely to arise in the future. Yet no knowledgeable observer can honestly say that the nation has been very successful in achieving the kind of basin programs evisioned by the supporters of the general concept.

This brings us to a point at which something needs to be said about the methods that have been devised to implement the basin program concept.

Methods

The supporters of the basin approach are, in general, divided into two groups. One group advocates the establishment of regional organizations along the lines of the Ten-

†"A Water Policy for the American People" pages 46-48.

‡See: "The Nation Looks at Its Resources," published by Resources for the Future, Inc., November 1954.

nessee Valley Authority. The other believes that the existing agencies of the federal and state governments should plan and carry out basin programs by joint and coordinated action.

It has been proposed that the entire nation be brought under regional agencies of the valley authority type. From the organizational standpoint, this is equivalent to proposing that a large part of the executive branch of the federal government be reorganized along geographic, rather than functional lines.

Opposed to the valley authority proponents are those who believe that the advantages of the present system should be retained, but that ways and means should be developed to insure that all of the activities of the functional organizations operating within a river basin, or region, are carried out in accord with a unified plan and schedule. This group believes that in this way the obvious advantages of the valley authority approach may be secured without loss of the equally obvious advantages of the present system under which the federal agencies think in terms of national problems and programs.

It must be pointed out, however, that at the present time it is the disposition of the Congress to favor the joint approach to basin development. This is indicated by the various attempts that have been made to implement the basic concept with which we are here concerned.

Attempts to Implement the Concept

It will be seen from what has previously been said of the Newlands' legislation of 1917 that at the time of the Conservation Crusade it was thought that full development of river basins could be achieved by bringing about coordination between existing agencies. The fact that even this modest effort failed may be one of the reasons why in 1933 a valley authority was established in the Tennessee Basin. While it must be admitted that the valley authority approach solved many of the problems inherent in the joint approach, it also demonstrated that the establishment of regional agencies gives rise to other difficult problems. As a result, proposals to establish additional regional agencies of the TVA type have not won the support of the Congress, or—it would seem—of a great number of informed citizens.

Several attempts have been made to arrive at comprehensive and coordinated basin programs by joint action. An early move in this direction was the joint planning done by the Inter-Agency River Basin Committees for the Missouri and Columbia River Basins. But in these basins the joint planning was rather limited in scope. A full scale effort was initiated as a result of the Flood Control Act of 1950 which provided for the formulation of a comprehensive and integrated plan for the region drained by the Arkansas, White and Red Rivers. This plan was developed by federal and state agencies working through the Arkansas, White, Red Inter-Agency Committee. A similar effort was made in the New England-New York region. Currently, the U.S. Army Corps of Engineers has underway the formulation of a broad plan for the Delaware River Basin, and has enlisted the aid of federal and state agencies in this undertaking.

Lessons

First of all we have learned that it is extremely difficult to achieve a truly coordinated basin plan when a number of agencies participate in its development. Experience indicates that the main obstacles to success are:

(a) Legislative deficiencies.

(b) The absence of adequate coordinating machinery.

(c) Deficiencies in present technical procedures.

(d) The natural selfishness of the human animal reflecting itself in what is commonly referred to as "bureaucracy".

Little need be said here about the deficiencies of the legislative base for cooperative planning. Every commission or committee established to consider resource policy has pointed out inconsistencies in the policies established by the diverse laws under which the various agencies operate. It is clear that there is an urgent need for the development of a consistent body of policy, and for legislative action to bring existing laws into accord therewith. The President's Water Resources Policy Commission in 1950 summed up the legislative requirements in these words:

> "The authority for the preparation of basin programs should be broad enough so that full and equitable consideration may be given to flood control, irrigation, navigation, power, municipal and industrial water supply, control of pollution, fish and wildlife, recreation, and the development, use and conservation of related land, forest and mineral resources."

Turning now to the second major obstacle—the absence of an adequate coordinating mechanism—it can be said that all formal reviews of water policy have resulted in recommendations that more effective coordinating machinery be established. The most recent recommendations are those of the Presidential Advisory Committee on Water Resources Policy. This committee recommended that basin, or regional, water resources committees be established, the chairman of which would be appointed by, and report to, the President. It also recommended the establishment of a coordinator of water resources in the Office of the President and the setting up of a permanent inter-agency committee to advise the President and the coordinator. President Eisenhower endorsed this recommendation and has since indicated that he intends to recommend specific legislation to implement it.

Certain groups have, as pointed out earlier, urged that coordination be achieved within river basins by the establishment of regional agencies of the valley authority type. Although at the present time there is relatively little support for this proposal, it must always be kept in mind that if the existing agencies fail to achieve an adequate degree of coordination, the nation is very likely to turn to the valley authority idea.

The third major obstacle mentioned previously was lack of technical know how. This may be surprising to some. But it must be remembered that within a major region there are many needs to be met by resource development, that there are usually a number of alternative ways of meeting these needs, and that there are a large number of individual projects which should be considered for inclusion in the plan. The ultimate objective of regional planning should be to find that combination of projects which results in the greatest net increase in the wealth of the nation. The nature of the problems which arise is illustrated by the task of finding the best system of reservoirs for a river basin. This problem has become very difficult as the result of the initiation of a federal program for controlling the floods of headwater streams by the construction of systems of small reser-

(Continued on page 151)

Field Efficiencies of 4-Row and 6-Row Equipment

K. K. Barnes
Member ASAE

T. W. Casselman and
Assoc. Member ASAE

D. A. Link
Assoc. Member ASAE

Agricultural engineers report results of comparative field efficiency studies of planting and cultivating equipment

FOUR-ROW planting and cultivating equipment for row crops has been standard practice on corn-belt farms for many years. Six-row equipment is now in production and is enjoying rapid acceptance by farmers. Some individuals are in effect operating 8-row planters assembled from two 4-row units.

The problem of appropriateness of 2, 4, 6, or 8-row units for a given farm situation is of concern to both farmers and farm machinery designers. The farmer must select the most profitable size of machine for his operations. The designers must predict the sizes of machines which will be in demand as patterns of agricultural production change.

Fig. 1 illustrates the problem of selection of the optimum size of machine from economic considerations. Assume that Fig. 1 refers to the production of corn from an area covered in one year by one planter, and that the cost curve includes the machine and labor costs attributable to the planting operation for the crop. The revenue curve is the total income from corn production on the area considered, and the return-over-cost is the revenue minus the cost. In this simple case the optimum size planter is the one which results in the maximum return over planting costs. It should be noted that this is distinctly different from the minimum cost planter. This is a distinction which is not always appreciated.

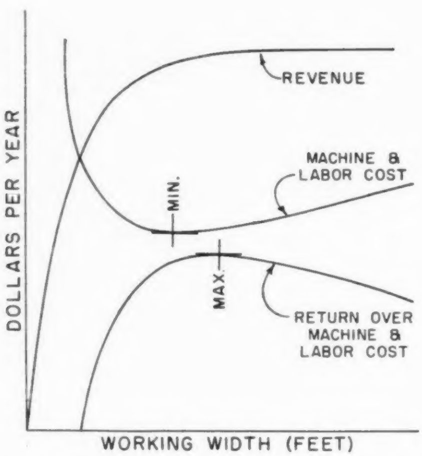

Fig. 1. Revenue, cost and return for machine operations as a function of the operating width of the machine or machine combination

The shape of the machine and labor cost curve results from the interplay of fixed costs and operating costs for the planter. A "small" planter has low fixed costs and high labor and other operating costs; a "large" planter presents a reverse situation. For a given acreage and cost structure there is, therefore, a minimum cost width.

The revenue curve reflects the timeliness factor in any field operation. In planting corn, for example, there is an optimum time to plant for maximum yield. Fig. 2 gives an extreme example of this situation as demonstrated by a date-of-planting test conducted by Iowa State College agronomists (3)* in 1949. The actual number of days available

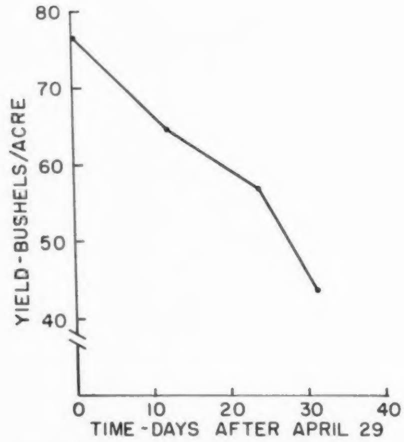

Fig. 2 An example of the influence of planting date on corn yield from a trial at Ames, Iowa, in 1949. From Rubis(3)

Paper presented at the winter meeting of the American Society of Agricultural Engineers at Chicago, Ill., December, 1958, on a program arranged by the Power and Machinery Division and approved as Journal Paper No. J-3528 of the Iowa Agricultural and Home Economics Experiment Station, Ames, Ia. Project No. 1331.

The authors—K. K. Barnes, T. W. Casselman, and D. A. Link—are, respectively, professor, associate, and graduate assistant in agricultural engineering, Iowa Agricultural and Home Economics Experiment Station.

*Numbers in parentheses refer to the appended references.

for planting in the corn belt is of course often severely limited by wet weather in May. A "small" planter in combination with unfavorable weather conditions may easily prolong the planting period to result in decreased yield and hence decreased revenue.

The selection of machinery of proper size requires either intuitive or analytical knowledge of the quantitative relationships in curves such as Fig. 1. Though successful farm operators seem to have this knowledge intuitively to a high degree, a more analytical understanding would be helpful to them and invaluable to engineers working with either the selection or design of farm machinery.

Field-efficiency values, through their influence on field capacities, are essential in determining both the cost and the revenue curves for any machine. The terminology adopted here is that set forth by Bainer, Kepner and Barger (1). Definitions are repeated for the convenience of the reader, as follows:

Theoretical field capacity is the rate of field coverage obtained if the machine were performing its function 100 percent of the time at rated forward speed and covering 100 percent of rated width.

Effective field capacity is the actual rate of field coverage by the machine based on the total field time (including operating time and time losses due to adjustment, field lubrication, breakdown, turning, filling hoppers, unloading, etc.).

Field efficiency is the ratio of effective field capacity to theoretical field capacity, usually expressed as a percent.

Bainer, *et al* (1) have pointed out that time losses in the field fall into two categories, *i.e.*, those losses which tend to be proportional to area and those which tend to be proportional to time. They present the following expression for field efficiency:

$$E_f = K \frac{T_o}{T_o + T_h + T_a} \qquad [1]$$

where K=percentage of implement width actually utilized

T_o=theoretical time required for an acre (reciprocal of theoretical field capacity)

T_h=time lost per acre due to interruptions that are proportional to theoretical time

T_a=time lost per acre due to interruptions that are proportional to area.

From equation [1] it is possible to gain some appreciation of the influence of machine width and the nature of the time losses on the relative field efficiency of 4 and 6-row equipment. Fig. 3 was plotted from data calculated from equation[1]. For 4-row field efficiencies (E_{f4}) of 50, 70, and 90 percent, Fig. 3 shows the ratio of the 6-row field efficiency to the 4-row field efficiency (E_{f6}/E_{f4}) as a function of the ratio of time loss proportional to area to time-loss proportional to theoretical time for the 4-row machine (T_{a4}/T_{h4}). Fig. 3 was constructed on the assumption that K was 100 for both the 4-row and 6-row equipment. For skillfully operated planting machinery, "overlap" will be negligible and K will be 100 for both the planting and the subsequent cultivating operations.

While this type of analysis is valid for any type of machine and could be applied to the determination of relative field efficiencies between any two widths of machine, it is of particular interest here to apply it to 4- and 6-row planters and cultivators. From suggested field efficiencies for 4-row equipment presented by Bainer *et al*(1), it may be assumed that 4-row planters might be expected to have a field efficiency of 75 percent and 4-row cultivators a field efficiency of 85 percent. Assuming that time losses for both of these machines tend to be largely proportional to area (say, $T_{a4}/T_{h4}=4$), Fig. 3 would lead to an estimation of E_{f6} of 68 percent for planting and 80 percent for cultivating.

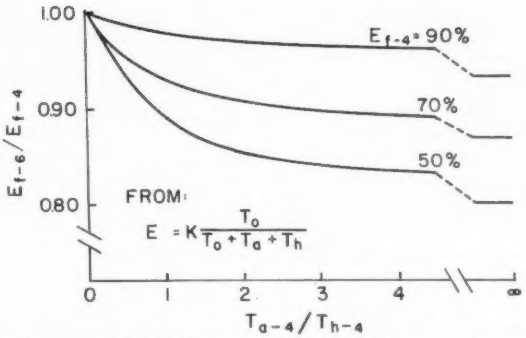

Fig. 3 Ratio of field efficiencies of 6-row and 4-row machines as a function of the ratio of time losses proportional to area to time losses proportional to theoretical time

A limited field study was carried out to check the validity of these estimates. This study, designed to compare the field capacities of 4-row and 6-row planting and cultivating equipment, was carried out in the spring and summer of 1958. The fields selected included some operated by Iowa State College and others operated by private individuals in the Ames, Iowa, area. Observers equipped with stop watches and clip boards followed the field operations noting and timing each activity of the operator in the field. Observational conditions and results are presented in Tables 1 and 2.

Direct comparisons of field efficiencies should not be drawn from Tables 1 and 2. The samples are obviously too

TABLE 1. RESULTS OF TIME STUDIES ON 4-ROW AND 6-ROW PLANTERS

Farm	The Situation: Area	The Situation: Total Field Time	The Situation: Speed of Op.	Time Losses: Turn at Ends	Time Losses: Adjust, Check, Clean,	Time Losses: Fill Boxes	Time Losses: Other	Capacities: Theo. Cap.	Capacities: Eff. Cap.	Field Eff.	Unit Losses: Time Per Turn	Unit Losses: Fill Boxes	Unit Losses: Adjust, Check, Clean
	Acres	Min	Mph	Min	Min	Min	Min	A/hr	A/hr	%	sec	sec/A	sec/A
4-ROW													
Fincham	17.65	224	4.80	9.0	7.5	39.0	31.6	7.74	4.73	61.1	10.8	132.5	25.5
Nelson	14.50	156	4.56	4.1	8.0	19.2	6.3	7.35	5.58	75.9	9.1	79.4	33.1
College	26.28	310	4.50	30.6	25.7	29.[illegible]	6.6	7.25	5.09	70.2	13.2	67.6	58.7
									Average		11.0	93.2	39.1
6-ROW													
Woodland	22.37	179	4.80	10.1	1.4	27.4	24.7	11.64	7.50	64.5	15.5	73.6	[illegible]7
Schonhorst	14.99	138	4.46	4.8	13.2	27.9	8.7	10.81	6.51	60.2	15.5	111.7	52.9
College	43.33	480	3.23	19.6	15.3	33.4	72.0	7.83	5.41	69.1	16.9	46.3	21.2
									Average		16.1	77.2	25.9

TABLE 2. RESULTS OF TIME STUDIES ON 4-ROW AND 6-ROW CULTIVATORS

Farm	The Situation: Area	The Situation: Total Field Time	The Situation: Speed of Op.	Time Losses: Turn at Ends	Time Losses: Adjust, Check, Clean	Time Losses: Other	Capacities: Theo Cap	Capacities: Eff. Cap	Field Eff.	Unit Losses: Time Per Turn	Unit Losses: Adjust, Check, Clean
	Acres	Min	Mph	Min	Min	Min	A/hr	A/hr	%	sec	sec/A
4-Row											
Fincham	8.36	81	4.79	1.6	4.2	10.2	7.72	6.19	80.2	7.45	30.1
Nelson	15.60	211	3.88	6.1	1.9	24.4	6.25	5.29	84.7	7.85	6.1
College	56.00	576	4.65	60.5	27.2	40.3	7.50	5.83	77.7	10.86	29.3
								Average		8.72	21.8
6-ROW											
Woodland	41.21	315	4.37	38.7	18.2	24.7	10.60	7.86	74.2	13.9	26.5
Schonhorst	30.84	291	3.80	22.8	13.5	52.9	9.21	6.36	69.1	25.9	26.2
Accola	15.39	120	3.85	7.1	13.9	0.0	8.95	7.69	85.9	11.0	54.2
								Average		16.9	35.6

. . . 4-Row and 6-Row Equipment

small for comparisons of mean field efficiencies to yield valid conclusions. The data include and illustrate the wide variety of field conditions and work habits found in a sample of farm operations. Turning at ends was sorted from other losses as being an activity common to all operations and when expressed as a unit loss, time per turn, unaffected by field size. Adjusting, checking, and cleaning form a group of activities common to all operators as do filling hoppers on the planters. These were also sorted out on a per unit basis.

Statistical treatment of the data indicated that for both planters and cultivators there was a significant difference in time per turn between 4-row and 6-row equipment. However, the variation in the data on filling hoppers and cleaning, adjusting and checking does not justify the conclusion that there was a difference in per acre losses for these activities.

To facilitate comparison of the performance of the 4-row and 6-row operations, the data for the unit time losses were used in an assumed standard situation of 4.5 mph and 1200-ft rows. Time per turn was assumed as observed for 4 and 6-row equipment and other unit losses were taken as the arithmetic means of observations on both 4 and 6-row equipment. The calculations and results are shown in Table 3.

TABLE 3. RELATIVE PERFORMANCE OF 4-ROW AND 6-ROW EQUIPMENT UNDER AN IDEALIZED CONDITION OF 1200-FT ROWS AND 4.5 MPH

Size of Machine	Theo. Cap.	Unit Losses			Eff. Op. Time	Total Field Time	Eff. Cap.	E_f	$\frac{E_{f6}}{E_{f4}}$	$\frac{C_6}{C_4}$
		Turns	Adjust, Check, Clean	Fill Boxes						
	A/hr	sec/A	sec/A	sec/A	sec/A	min/A	A/hr	-	-	-
PLANTERS										
4-row	7.3	29.9	32.4	85.2	496	10.72	5.59	76.5	0.908	1.35
6-row	10.9	29.2	32.4	85.2	330	7.94	7.56	69.4		
CULTIVATORS										
4-row	7.3	23.7	33.7	-	496	9.23	6.50	89.0	0.940	1.40
6-row	10.9	30.6	33.7	-	330	6.58	9.11	83.6		

Table 3 indicates that increasing machine width by 50 percent from 4 to 6-row increases actual capacity by 35 percent for planters and 40 percent for cultivators. The calculated field efficiencies of 69.4 percent for 6-row planters and 83.6 percent for 6-row cultivators agree well with estimates 68 percent and 80 percent, respectively, which were previously made. The field efficiencies for the "standard situation" are somewhat higher than those actually observed. The actual situations often had shorter rows. They also had losses associated with failure to maintain their intended operating speed, rest periods, and miscellaneous activities. The magnitude of these losses is indicated in the columns labeled "other" in Tables 1 and 2.

Field size, shape and topography often present severe limitations to the application of equipment of increasing size. A specific example of this may be drawn by calculating the ratio of 6-row to 4-row effective capacity for planters, based on the time required per turn determined in this study. Results of such a calculation are shown in Fig. 4. It should also be mentioned that in many farm situations improvement in seed and fertilizer handling patterns might well increase effective planting capacity as much as would the change from a 4-row to a 6-row planter.

Equation [1] implied that losses in the field may be specifically identified as proportional to area or proportional to theoretical time. Bainer *et al*(1) have wisely used the phrase "tend to be proportional" to emphasize the difficulty of actually separating time and area losses in field observations. The time loss data on a per acre basis in Table 3 indicate that the losses in planting and cultivating are largely proportional to area. Though the field data are limited, they serve as good check points on judgment estimations of the relative capacities of 4 and 6-row equipment. The variation of performance among individual operators is so great that it is doubted that more extended field studies would yield results which would be more valuable in relation to their costs.

The inevitable question from the practical minded reader is: What acreage justifies 6-row planting and cultivating equipment? The answer is available if one can assign specific numerical values to Fig. 1. Link(2) has developed an analytical procedure for complete solution of Fig. 1 for given situations. Details of the method are beyond the scope of this paper. However, it should be pointed out that the optimum width depends among other things on evaluation of the revenue curve as a function of width. This definition of the revenue curve is dependent upon quantitative knowledge of the timeliness effects in planting and cultivating. Such knowledge is virtually non-existent and it has been necessary to make some rather bold assumptions.

The revenue curves as a function of width result, therefore, from a judgment evaluation of the average yield depression over the years, resulting from the weather hazard risks associated with equipment of a given size. In calculations for the optimum curve these risks are assigned values which reflect the depression in yield to be anticipated if machine size delays the operation on a given increment of land. Assumed values of yield reduction were one-half bushel per acre per day for planting, one bushel per acre per day for first cultivation, and one-half bushel per acre per day for second cultivation. Based on these assumptions the 4-row planter was found to be the optimum size for 86 acres of corn and the 6-row planter was found to be the optimum size for 126 acres of corn. The magnitude of the change in return over costs for this range of areas is not large. Furthermore, the characteristic shape of the return curve in Fig. 1 indicates there will be less depression in returns by erring in the direction of too large a machine rather than in the direction of too small a machine.

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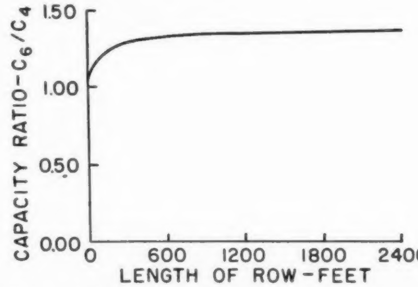

Fig. 4 Ratio of effective field capacities of 6-row and 4-row planters as a function of row length

. . . Solar Energy

(Continued from page 144)

of limited production prevents the large market from appearing.

The entry of industry into this field will probably have to wait until either the government deems it advisable to encourage such a move or some technical breakthrough makes it obvious that a vast potential market exists.[1] This breakthrough may take the form of new material and/or fabrication techniques. However, material prices are already low enough so that if a manufacturing markup similar to that of the automobile industry could be applied, there would be collectors presently on the market which would compete favorably with conventional fuels. Again technical advance may take the form of new uses for collected energy, notably refrigeration. At present, work is being done in this field and early results seem encouraging. Successful absorption systems utilizing solar energy would open up vast markets for refrigeration in areas where there is ample sunshine but little use for collected heat.

Potential Applications

There are many other potential uses for the intermittent low grade energy from solar collectors. Space heating (and possibly cooling) is only one, although important, use. Power generation is possible using collectors having three, four or more transparent cover plates to generate steam at atmospheric pressure, lowering the absolute pressure so that boiling can occur at lower temperatures, or even using refrigerants having still lower temperatures at the vapor phase. In Italy this last-named alternative has been developed to the point of commercially available pumps, chiefly for rice field irrigation and similar tasks.

Certain industries might well be able to substitute solar heat for steam, often piped considerable distances in sparsely built-up industrial plants, in order to warm viscous fluids or liquids for other processes. The larger the volume of the tank of fluid being warmed, the less important the insulation problem and the intermittent nature of the heating.

In agriculture, also, a number of potential uses come to mind. Grain and hay drying with air heated by flat plate collectors is one such use. The warming of ventilating air for poultry houses and stock barns with consequent savings in feed and/or fuel is another. It should be noted, however, that the seasonal nature of usage with a consequently low load factor on the collection device make the economic aspects of solar heat utilization even more critical in agriculture than in the industrial or domestic field. Extremely low cost or multi-use portable devices is probably the answer to this problem.

The uses of solar energy in biological processes is a field which is receiving considerable attention and will probably result in growth cycles for proteins, carbohydrates, and even fats through the mechanism of yeast or algae type plant forms which far exceed any presently practiced agricultural processes in efficiency of energy utilization. Any analysis or even description of such processes is beyond the scope of this paper.

It is probably safe to say in summary that there has been sufficient experimentation, engineering analysis, and development done on the construction and utilization of solar energy equipment to warrant considerable industrial interest in the immediate future. The situation now waits for the appearance of manufacturing concerns able and willing to pass through the developmental deficit period, perhaps with governmental encouragement, and tap a market potentially so large as to be indefinite in extent.

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. . . River Basin Planning

(Continued from page 147)

voirs. Within a major river basin there may eventually be thousands of these headwater reservoirs storing, in the aggregate, several inches of runoff from the entire basin. There are also problems in the main valleys which can best be solved by the provision of major reservoirs. A little thought will show that the task confronting the planner is to find that combination of reservoirs—large, small and intermediate in size—which provides the maximum net benefits. This requires the evaluation of the physical and economic effects of many possible combinations of reservoirs. Obviously, the volume of calculations required will be prohibitive if it is not possible to devise new techniques, such as the adaptation of electronic computers to the design of reservoir systems.

The fourth, and last, major obstacle previously alluded to is the difficulty of getting human beings to work as a team toward a common objective. There is a perfectly natural tendency for each agency to seek to magnify its own importance in the scheme of things. This would be difficult enough to overcome even if all of the groups were operating under the same legislative directives, under the same policies, and under an effective coordinating mechanism. In the virtual absence of these essentials, it is no wonder that "bureaucracy" constitutes such a fearful impediment to attainment of the kind of plans the nation must have if it is to make the most of its dwindling supply of natural resources.

This human problem will be minimized if the three other major obstacles are overcome. It is devoutly to be wished, therefore, that the Congress will see fit to put in effect reforms along the line of these recommended by the Presidential Advisory Committee on Water Resources Policy. But even should it do so, the problem of controlling the bureaucratic tendencies of the cooperating agencies will still be a major one. Hence, there will also be a need for broadening the horizons of governmental employees and for continually fostering in their minds the idea that they are members of a far larger and more important team than the single organizational unit which happens to carry them on its payroll. They must be encouraged to look upon themselves as members of a task force responsible for the successful accomplishment of a mission far transcending the capabilities of the individual units of which it is composed.

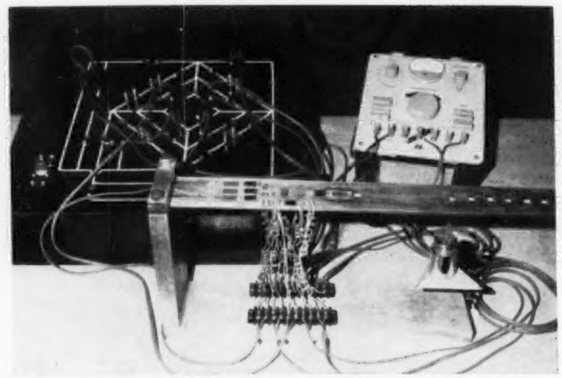

Fig. 1 Wheatstone bridge plugboard, cantilever beam model and Baldwin static strain indicator as used for a classroom exercise

Strain Gage Teaching Aids

Roger Yoerger and **Robert G. Light**
Member ASAE — Assoc. Member ASAE

Working models simplify teaching of principles and applications of strain gages

IN some colleges the undergraduate student in agricultural engineering has little or no opportunity to become familiar with the use of the SR-4 electrical resistance strain gage and associated instrumentation from coursework taken in engineering mechanics or mechanical engineering. The need then arises of taking time from courses in agricultural engineering to teach the principles of instrumentation and gage use. Problems are often encountered in using existing installations of gages for instruction in that the gages may be installed in remote locations and not actually visible because of waterproofing procedures. Also, the electrical connection of the gages may be rather obscure and not easily altered.

To fulfill the need for class room aids in teaching strain gage principles and techniques several working models were constructed. A special Wheatstone bridge plugboard that can be used in conjunction with the conventional instrumentation is shown in Fig. 1. The plugboard consists of three concentric bridge configurations connected as shown by the white lines on the surface of the board. With this unit it is possible to interchange or relocate gage elements in the bridge, place gages or resistances in series or parallel in any bridge arm, desensitize the bridge, etc., by simply moving plugs. The individual corners of the bridge are connected to output plugs and also to a five lead Amphenol AN connector. The surface of the board is ⅛-in. Masonite and the plugs and jacks (type 274) are available from the General Radio Co., Cambridge, Mass.

The model shown in Fig. 1 consists of an aluminum base with a stainless steel cantilever beam 3/16-in. thick, 2½ in. wide and 24 in. long. A total of 10 SR-4 gages are mounted on the beam as shown in Fig. 2. By various arrangements of the gages in the plugboard Wheatstone bridge, it is possible to obtain indications of many different phenomenon. Examples of some of the bridge arrangements are also shown in Fig. 2.

The two models shown in Fig. 3 illustrate the use of gages to measure torsional strains and torque transmitted through a shaft. Unit A consists of an aluminum frame with a 1-in. diam. steel shaft rigidly mounted to the standard at one end and passing through a removable bushing in the standard at the other end. A hexagonal head has been filed on the free end of the shaft to accommodate a ⅞-in. socket. At one location on the shaft four gages are oriented on 45-deg helices with the axis of the shaft and at a second location one longitudinal gage has been placed on top and one on the bottom of the shaft. By applying a torque to the free end of the shaft, using various gage configurations in the plugboard and inserting or removing the shaft bushing,

An "Instrument News" contribution. Instrument News (Karl Norris, Editor) is sponsored by the ASAE Committee on Instrumentation and Controls. Articles on agricultural applications of instruments and controls and related problems are invited and should be submitted direct to K. H. Norris, 105A South Wing, Administration Bldg., Plant Industry Station, Beltsville, Md.

The authors — ROGER YOERGER — is associate professor agricultural engineering, University of Illinois, Urbana, former associate professor of agricultural engineering, The Pennsylvania State University, University Park, and — ROBERT G. LIGHT — is assistant professor of agricultural engineering, University of Connecticut, Storrs, former instructor in mechanical engineering, The Pennsylvania State University.

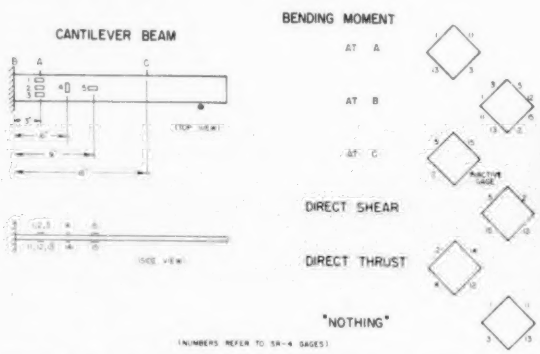

Fig. 2 *(Above)* Cantilever beam model showing gage locations and examples of some of the possible gage arrangements in the Wheatstone bridge

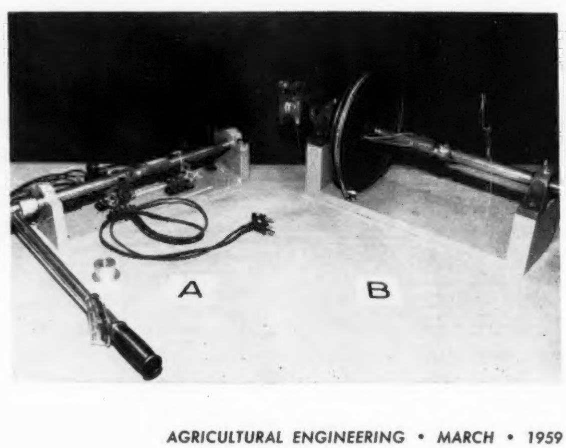

Fig. 3 *(Right)* Models for demonstrating the use of SR-4 gages to measure torque and torsional strain in a circular shaft

Strain Gage Teaching Aids

(Continued from page 152)

it is possible to illustrate torque measurement, bending moments, cancellation of bending moments, temperature compensation, etc.

Unit B in Fig. 3 shows a shaft installation for measuring torque during rotation. One end of the shaft is driven and a rope brake is applied over the sheave on the other end. The signals from the SR-4 gages mounted on the middle of the shaft are transmitted through a mercury bath collector cell to the indicating instrument.

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. . . Soviet Farm Mechanization

(Continued from page 136)

ized evaluations. The factory representative may be present during the test. The results of the test, published by the Ministry of Agriculture, are used to determine whether or not a particular machine goes into production. It was reported that there are now 23 MTS and plans for three more are being formulated.

Although there appears to be a concerted effort to speed up farm machinery production, a tremendous gap exists between the needs and the available machines. It will be interesting to see how long it takes to fill the void.

Machines other than tractors and combines, are likewise being given much attention, sugar beet harvesters being an outstanding example. Although the most common harvester, usually a 3-row, moves rapidly, and it is said that the harvest is practically 100 percent mechanized on the larger farms, it was noted that "machine-harvested" beets were always retopped from the field pile by women using hand knives. This was estimated to require about an additional 30 "woman" hours per acre. Discussions also indicated about the same labor requirements for chopping and thinning the beets with the result that the overall process is considerably less than 100 percent mechanized.

In conclusion, to an agricultural engineer from the United States, the Soviet view is one of contrasts. On the one hand there are strong programs of research, teaching, and development together with up-to-date models of some of the major farm machines. Considerable advances have also been made in mechanizing some of their major crops. With the present heavy emphasis on technical education and farm machinery development, one may well wonder if the Soviets may soon be in a position to "export" engineers and technicians as well as some farm machines.

In contrast we see much of the work still being done by hand methods, a great deal of this by women. Little progress has been made in mechanizing the farmstead work. There appeared to be plenty of labor available and increased efficiency in this area will likely be slow in coming.

Engineering Enrollment Down

FOR the first time in seven years, and despite still-critical demands for engineering talent, enrollment in American engineering schools is on the decline, according to a report by the American Society for Engineering Education.

The following engineering enrollment figures were obtained in an annual official survey of students and degrees conducted by the American Society for Engineering Education in cooperation with the U.S. Office of Education, and reported by Justin C. Lewis, Head of Higher Education Statistics, and Dr. Henry Armsby, Chief for Engineering Education, both of the U.S. Office of Education:

The 153 accredited American engineering colleges had 2.9 percent less students in the fall of 1958 than in the fall of 1957. The freshman class which entered last fall was 11.6 percent smaller than 1957, with an enrollment of 59,164 instead of 67,017.

Declining enrollments have not yet affected the number of engineering graduates, which number 31,216 in 1957-58 compared with 27,748 the previous year. But the numbers are far short of the record graduation of eight years ago, when World War II veterans were finishing their delayed college careers.

Fears of dropping engineering enrollments were confirmed by the official figures. Engineering students are now less than 7.7 percent of all American college students, compared with nearly 8.5 percent in 1957. Enrollment of second-year students is down 6 percent from last year, and third-year students are down 4 percent. Only through the fourth and fifth-year category does the 1958 enrollment total as large as in 1957. This gives promise of more graduates in June 1959; but there may be fewer in the years thereafter.

Graduate study in engineering continues to increase sharply, according to the report, and enrollment is now at record levels. A total of 27,456 students were enrolled in master's degree programs in the fall of 1958, an increase of 14.7 percent over 1957, and 4,762 were studying for doctor's degrees, an increase of 14.3 percent.

Last year 5,751 master's degrees were given in engineering, nearly 10 percent of the master's degrees given in the United States during the year. There were 653 doctor's degrees in engineering, or 8 percent of doctor's degrees given in all fields.

Transactions of the ASAE

THE deadline for ordering the second edition of the TRANSACTIONS of the ASAE to be issued by midyear 1959 is March 30. Since press run will be determined by advance orders, availability of copies cannot be guaranteed beyond closing date. The first edition, consisting of 96 pages, was mailed to all members of ASAE and subscribers of AGRICULTURAL ENGINEERING. The second edition will contain at least 128 pages of technical agricultural engineering papers and is being offered for $5.00 ($2.50 to ASAE members). To make sure you will receive the second edition send your order to ASAE, 420 Main St., St. Joseph, Mich.

. . . Chaos or Order?

(Continued from page 133)

ing office auditor learns that the weight per measured bushel of most of the wheat is 58 pounds and that this conforms to the minimum test weights of 57 or 58 pounds per bushel required in the grades promulgated by the U.S. Department of Agriculture for No. 2 wheat, the prevalent grade handled. He wants to know why storage rates were paid on 60 pounds per bushel when wheat of 58 pounds or less test weight was actually stored. Think of the millions of dollars he can see involved in the apparent discrepancy. The sum is enough to appall a taxpayer and overwhelm a court. You may imagine several other perplexing questions the auditor may raise in his zeal for an accurate accounting of expenditures of Government funds when he fails to recognize that the bushel is used as a measure of weight in the one instance and as a measure of volume in the second instance. The best answer he frequently gets to his questions from entirely literate clerks and officials handling the accounts is "We don't know the reason, we know only that it is done this way."

No less grievous problems occur in market news from the Pacific Coast States. In Pacific Coast markets trading in barley is in ton and hundredweight units. Here the market news reporter endeavoring to summarize data nationally on terminal market receipts or stocks must convert to a common denominator of 48 pounds per bushel, the trading unit used in the rest of the United States. Price comparisons between markets also require similar conversions. Portland and San Francisco usually quote prices for barley of 45 pound test weight and Los Angeles for 46 pound test weight. Since test weight is an important quality designation, reference is made to it in market news reports. It is not used in any way to convert hundredweight or tons to bushels, but for many people who use the data this is difficult to understand.

Enough additional examples were presented to convince me that marketing agricultural products is only for professionals. The uninstructed, the consumer and too often the farmer, is at the mercy of our system. Further quotes from Mr. Trelogan's paper illustrate the position we are in.

"In addition to the pound, gallon and bushel, when agricultural products go to market many of them are sold by count or per container, of which there are a tremendous number of different kinds, shapes and sizes. Agricultural products are marketed in bags, bales, barrels, baskets, boxes, crates, cans, cases, drums, hogsheads, jars, tubs, and other containers.

"Of all these containers only two kinds, the barrel and basket, have their sizes specified by Federal law. When used for agricultural products, the legal sized baskets are the half-pint, pint, quart, and multiples thereof, including the bushel. However, with a few exceptions, there is no limitation as to their shape. One hundred and three known shapes and sizes are now in general use.

"It is not known how many different boxes and crates are used to market agricultural products, as they are not limited by law, but railroad freight traffic schedules list more than 100 of them.

"Cans used for agricultural products have a system of size designation originated by can manufacturers. It is a combination nomenclature system with cans of certain sizes referred to by numbers 1 through 12, and other can sizes designated by their actual height and diameter in inches. To illustrate, one of the most common can sizes now in use for vegetables is the 303 by 406 can, usually referred to as the 303. It is 3³⁄₁₆ inches in diameter and 4⁶⁄₁₆ inches high. Wholesale trading of canned products is usually done on a per case basis with the cases normally containing from 6 to 48 cans in multiples of six, depending on their dimensions. About 75 different can sizes are now commonly used for agricultural products. A recent inquiry among housewives indicates that about 3 in 100 are able to state with a reasonable degree of accuracy the ounces in cans of the most popular can sizes. Less than 4 in 100 could estimate the number of servings reasonably well."

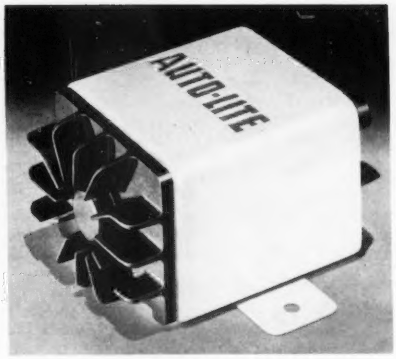
Chaos or order — presently we have neither. We are somewhere between with the opportunity of seeking either. Complete order will never be achieved because of the multitude of sources from which measures spring but we cannot afford to drift toward chaos.

What can we do to improve our system of measurements? Historically once a measure is accepted by society, it is extremely difficult to change it, due largely to familiarity. This suggests one method of encouraging change—through education. Using an improved system educationally may develop a facility and liking for the system even though in every day life one may use a different system. In time the improved system can replace the old everyday system. The first class of Mechanical and Aeronautical Engineers at Purdue will graduate in 1960 having been taught using the decimal-inch system in their basic engineering drawing courses. It is an improved inch system that can help materially in simplifying measurements and lends itself to an educational introduction.

Of great importance is that a new measurement be scrutinized carefully before its introduction to society to learn whether it pushes us in the direction of order or chaos. If few who originate new measures take the responsibility of doing this, we will be found with a plethora of new measures as our knowledge is enlarged and our spatial references change.

The American Society of Agricultural Engineers should assume the responsibility for evaluating newly-proposed measures that are created from the activities associated with the Society. We are now conducting research in agricultural processing and quality evaluation and control that will undoubtedly create new measurements. Also, the Society should evaluate our present system of weights and measures to determine how much we can benefit from change. Of immediate interest should be an evaluation of the decimal-inch system.

At the Washington meeting it was predicted that automation and the computer will make the fraction obsolete. It might further be predicted that our computing machines will force us to make the changes in our weights and measurements system that we admit are sound but are reluctant to make. Let's not have machines force our hand. The responsibility for new measurements that we create is ours and the system we use is of our own choice.



New "Transicoil"

Improved Ignition System

New development in high-voltage transistorized ignition system offers increased longevity and dependability — an advantage when engines are required to function unattended for long periods of time

A NEW high-voltage transistorized ignition system, described as a major break-through in ignition engineering and one that offers reductions in engine design restrictions resulting from the conventional ignition system, has been introduced by the Electric Auto-Lite Co. in a recent press conference demonstration. Immediate applications include industrial engines required to function unattended for long periods of time; such as those used in irrigation systems, pumping stations, heat pumps, air conditioning systems, and similar installations.

Introduction of a transistorized coil in the conventional ignition system to replace the conventional coil and condenser, reportedly increases longevity of the ignition system so much that the manufacturer feels safe in predicting over 3500 hours of maintenance-free service. This service, they report, is at the system's designed level throughout its operating life, exhibiting little, if any, depreciation of performance with age.

Based on laboratory endurance testing, these characteristics mean that the new system will effectively lengthen the period the engine can operate unattended, substantially reduce the time the engine is not operating because of ignition repair and maintenance and, along with the savings in "down time," reduce the labor and parts costs otherwise incurred.

Main reason for these performance characteristics is that the new system removes the restrictions placed on system life by the electrical longevity of the distributor contacts. In switching the current loads in conventional ignition systems these contacts are subjected to electrical erosion, metal transfer and oxidation and, as a result, destroy themselves. In the process, starting is made difficult, engine efficiency is decreased and ultimately ignition is halted until the contacts are replaced. The new system still employs the conventional distributor contacts to time the firing to the engine but the current switched by the contacts is approximately 30 times less. Triggering the base circuit in the transistor system, the contacts have been tested in the company's endurance laboratories for more than 3500 hours with no signs of electrical erosion or metal transfer. Cold weather starting tests have shown oxidation to be completely eliminated.

How Does the New System Work?

Special circuits and other features of a new voltage transformer realize for ignition use the unique ability of transistors to switch large currents through the action of a small control or relay current. The base circuit of the transistor carries this current and is triggered by the distributor contacts, thereby timing the firing of the transistor switched transformer to the engine. The distributor contacts function in their normal manner except that they carry a greatly reduced current load and, through the action of the transistor, set off a chain reaction that makes it possible to deliver greatly increased voltage to the spark plug.

Advantages

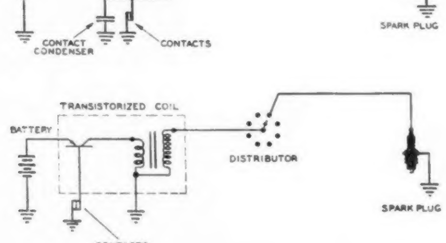
Immediate advantages of transistorized ignition include:

- Unlimited contact life
- Elimination of "blue points" and associated poor cold weather starting
- System performance that does not deteriorate with age
- Voltage output for firing the spark plug that is constant throughout engine speed range. This provides performance equal to battery ignition at low speeds and a magneto system at high speeds.

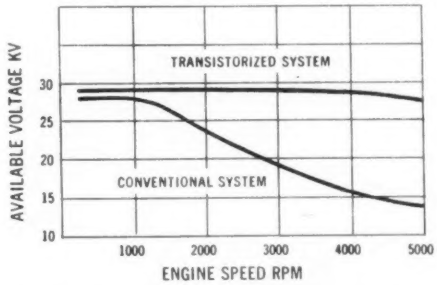
By making substantially higher voltages available at the spark plug in a practical manner, this new system lifts the design ceiling imposed on engine designers and fuel makers by the conventional ignition system. Inherent in the design is the capacity to produce even higher secondary voltage when needed.

This new device incorporates the transistor, its heat sink, the transformer and associated circuitry in a single package with two primary terminals and a secondary high tension tower as in an ignition coil. This package is completely compatible with components of any battery ignition system and has universal application, it is said.

The company reports that units are available now for testing by engine and tractor manufacturers and fleet operators. Further information may be obtained by writing to The Electric Auto-Lite Co., Toledo, Ohio.



Conventional ignition system is shown at top. In lower diagram transistorized coil replaces conventional coil and condenser



Transistorized system output is equivalent to a battery ignition system at low speeds and magneto system at high speeds

Instrumentation Exhibit Planned

The Committee on Instrumentation and Controls is sponsoring an exhibit for the Annual Meeting of ASAE to be held at Cornell University, Ithaca, N. Y. June 21-24. Any individual or organization engaged in agricultural engineering research is qualified to enter an exhibit. The exhibits should demonstrate originality in the development of new instruments, or in the application of commercially available instruments to research problems in agricultural engineering.

The acceptance of exhibits will be based upon the judgment of the Instrumentation and Controls Committee and on available space. Persons desiring to enter exhibits should send a description of each exhibit along with the minimum space to Gerald S. Birth, 105A South Wing Administration Building, Plant Industry Station, Beltsville, Md. All entries should be in by May 15, 1959.

FEI Staff Expanded

A recent expansion of the Farm Equipment Institute's staff includes a widely recognized agricultural management specialist, Charles L. Dickinson, former lecturer in Agricultural Industries Management, Graduate School of Business and Public Administration, Cornell University, Ithaca, N. Y. He has been associated with agricultural businesses since 1925 as a ranch manager in California, a dairy farmer in New York and for the past twenty years, as an executive in one of the nation's largest businesses dealing with farmers. He joined the faculty of the Graduate School in Cornell in 1957 and holds life membership in the New York State Agricultural Society. At one time he was president of the Northeast Radio Corporation, director of the Empire State Chamber of Commerce, and a trustee of the Citizens' Public Expenditure Survey.

In announcing the new appointment, George A. Kelly, II, president of FEI and president of G. A. Kelly Plow Co., Longview, Tex., reported that the addition of Mr. Dickinson to the staff will be a tremendous help in the development of an expanded program of economic, statistical, marketing and research services for farm equipment manufacturers, which he explained is an important step in the new FEI "Program for Greater Service" to its manufacturer members.

Engineers, Scientists and Architects Day

Washington, D.C., members of ASAE participated in celebrating Engineers, Scientists and Architects Day, February 25, 1959, at the Willard Hotel. It was sponsored by the D. C. Council of Engineering and Architectural Societies, The Washington Academy of Sciences and the Joint Board on Science Education, comprising some 60 organizations.

Dr. Robert M. Page, director of research, Naval Research Laboratory, spoke on "Frontiers of Space Science" at the morning session. He explored the terrestrial environment and expanded to lunar characteristics, neighboring planets, solar phenomena, the local galaxy and interstellar space.

At the luncheon session, national capital awards were made to an outstanding young engineer, scientist and architect. Citations were presented to an additional 12 nominees for professional awards and 62 for science teachers awards. The luncheon speaker was Dr. Sydney B. Ingram, director of education and training, Bell Telephone Laboratories, and his subject "Education for Age of Technology."

Of the 450 in attendance, 10 were members of the Washington Section ASAE. They were: Lowell E. Campbell, Leo E. Holman, E. G. McKibben, Karl H. Norris, Barton C. Reynolds, J. P. Schaenzer, Archie A. Stone, John G. Sutton, Merrill S. Timmins, Jr., and Galen C. Winter.

Cotton Ginning Scholarships

Fellowships worth $2,500 each are available to outstanding students for a one-year graduate study in cotton ginning engineering at Clemson Agricultural College, Clemson, South Carolina. The Foundation for Cotton Research and Education, Memphis, which handles the fellowship grants, reports that students successfully completing the work at Clemson will receive an M.S. degree in agricultural engineering with ginning engineering emphasis. Funds for the fellowships are provided by the Clayton Fund, Houston; Continental Gin Co., Birmingham; and the Murray Company of Texas, Inc., Dallas. Interested candidates may obtain additional fellowship information and application form immediately from the National Cotton Council, Post Office Box 9905, Memphis 12, Tenn.

Radioisotope Training

The Atomic Energy Commission has announced a new program of assistance to colleges and universities for education and training in radioisotope principles and technology. The purpose of the program is to foster the widespread use of radioisotopes through the training of scientists, engineers and technicians. The program provides for assistance to colleges and universities in obtaining demonstration apparatus, student laboratory equipment, and training aids for course work in radioisotope technology. Information regarding the submission of proposals and the requirements for assistance can be obtained from: Director, Office of Isotopes Development, U.S. Atomic Energy Commission, Washington 25, D.C.

Beef and Dairy Equipment Plans

A new "Beef and Dairy Equipment Plans" book has been published by the Midwest Plan Service, a cooperative activity of the 13 North Central Land Grant Colleges and Universities with headquarters in the Agricultural Engineering Building at Iowa State College. It is described as detailing everything from feed lots to silage carts and from mechanical bunks to livestock trailers. The 56-page volume—price $1.00, format 8½ x 11 inches — includes 59 complete working plans plus 10½ pages of construction details and an additional five pages of design, layout and equipment-selection data. Also included are 23 sample layouts of feeding and handling systems. The book has been edited with an eye toward being a valuable sales tool for rural lumber dealers and contractors, but it will also have a place on the reference shelves of dairy and cattlemen, counselors and teachers. It should be a valuable edition also to the working library of personnel in allied beef and dairy industries.

The volume is available from the extension agricultural engineer at any of the following: University of Alaska, Michigan State University, North Dakota Agricultural College, University of Illinois, University of Minnesota, Ohio State University, Purdue University, University of Missouri, South Dakota State College, Iowa State College, University of Nebraska, University of Wisconsin, Kansas State College, and Midwest Plan Service Headquarters, Iowa State College, Ames, Ia.

5th Nuclear Congress

The 5th Nuclear Congress, sponsored by 30 engineering, scientific and industry organizations including ASAE, will be held April 5-10 at the Public Auditorium, Cleveland, Ohio.

The 1959 Nuclear Congress, coordinated by Engineers Joint Council, is an assembly of three important conferences and an exposition showing the latest in atomic developments consisting of the 5th Nuclear Engineering & Science Conference, the 7th Atomic Energy in Industry Conference, 7th Hot Laboratories & Equipment Conference and the Atomfair. The Atomfair is an exhibit by major manufacturers of the latest products, components, and services for the peaceful use of atomic energy.

Registration for the Nuclear Engineering & Science Conference and the Hot Laboratories Committee for the Congress will be conducted on Monday, April 6 through Thursday, April 9 at the Public Auditorium. Registration for Atomic Energy in Industry Conference will be conducted by the National Industrial Conference Board at the Statler Hilton Hotel Wednesday through Friday, April 8 to 10. Copies of the program will be available from ASAE Headquarters, P.O. Box 229, St. Joseph Mich.

April Date Set for 1000-RPM PTO Machines

John Deere, Moline, Ill., announces that engineering work on tractors and implements has been completed and that machines conforming to the recently approved ASAE-SAE 1000-rpm power take-off standard will be available after April 1.

It was also announced that John Deere tractors will be manufactured for both 540-rpm and 1000-rpm PTO operation. New power-driven machines will be available with either 540 or 1000-rpm drives. In addition, owners of many older model tractors and implements may convert to 1000-rpm operation at nominal cost.

The company offers these choices to farmers:

1. Tractors manufactured after April 1, 1959, will be available with either 540 or 1000-rpm powershafts.

2. Implements manufactured after April 1, 1959, will be available with either 540 or 1000-rpm drives.

3. Current and many older model tractors, equipped with a live PTO, can be dealer-converted to 1000-rpm operation through internal gear conversion kits.

4. Farmers who anticipate powering both 540 and 1000-rpm equipment can equip their tractors with an external powershaft speed changer to change from 540 to 1000-rpm or vice versa.

5. Conversion kits will be available for all new and many older model implements to change the PTO drive from 540 to 1000-rpm.

Names Contractor for United Engineering Center

General contractor has been named for the United Engineering Center, the new headquarters of several engineering societies to be erected on the west side of United Nations Plaza between 47th and 48th Streets in New York. The center, a $10,000,000 tower structure of 18 stories, with about 260,000 sq ft of floor space, will house 10 national engineering societies representing nearly 250,000 members. Engineering Societies Library, said to be the nation's most comprehensive repository of vital technical information, will also be housed in the center, as will five joint groups dealing with engineering research and improved educational standards.

Space has been set aside in the building for educational exhibits which will dramatize the creative role of engineers in advancing world living standards. The metal, glass and limestone structure, fully air-conditioned, will occupy a site of 37,000 sq ft.

The United Engineering Trustees, Inc., an organization set up by participating engineering societies to perform management functions in their joint behalf, is in charge of the planning and operation of the new center. UET now operates the 50-year-old engineering headquarters at 29 West 39th St., New York, which now houses many of the societies which will occupy the United Engineering Center.

Engineering groups which will be housed in the new center include: American Institute of Chemical Engineers; American Institute of Consulting Engineers; American Institute of Electrical Engineers; American Institute of Industrial Engineers; American Institute of Mining, Metallurgical and Petroleum Engineers; American Society of Civil Engineers; American Society of Heating, Refrigerating and Air Conditioning Engineers; The American Society of Mechanical Engineers; American Welding Society, and the Society of Women Engineers.

Alumni Establish AE Scholarship

David Currence, a freshman at the University of Missouri from Eldon, Mo., has been selected to receive a $150 Agricultural Engineering Alumni Scholarship, according to M. M. Jones, chairman of the agricultural engineering department.

The winning student was selected to receive the scholarship on the basis of his high school grades, aptitude for college work, character, need, and interest in agricultural engineering. He intends to make the design and testing of farm machinery his major field of study.

University agricultural engineering graduates established the scholarship fund in 1958 and Currence is the first student to receive the grant. The agricultural engineering alumni intend to continue making the scholarship available on an annual basis.

Surface Irrigation Research Reports Available

Copies of the report "Recent Research on the Hydraulics of Surface Irrigation" prepared by the Committee on Surface Irrigation of the ASAE for distribution during the 1958 Annual Meeting of ASAE in Santa Barbara, Calif., are now available from ASAE Headquarters, at no charge.

The data contained in this manuscript were compiled in May 1958 at the agricultural engineering department, Washington State College, Pullman, and lists research references on flooding methods, furrow methods, infiltration and efficiency, and measurement and conveyance.

Announces Plans for Agricultural Engineering Technorama

A TECHNORAMA of Agricultural Engineering, a new multi-million dollar building designed for the purpose of housing an indoor display and educational center, showing the latest agricultural equipment, materials and processes, will become a reality on the Michigan State University campus at East Lansing in 1960, according to a report from A. W. Farrall, head of agricultural engineering department. Plans and policies covering this project were outlined to an enthusiastic group of industry and educational representatives at a special meeting at Michigan State University January 21. The new-type educational facility is designed to be especially suited for manufacturers to show their modern products and processes dealing with the application of engineering to the farm, the home and industry. Plans indicate that the new center may also be coordinated with the present teaching and research facilities and a proposed agricultural museum and historical library.

In addition to serving farmers, agricultural advisors, teachers and students, the new structure will provide a focal point where foreign visitors can see the latest developments in the application of engineering to agriculture. The building will be available to farmers, 4-H, Future Farmers, agricultural engineers, industrial groups and others for programs and demonstrations. Meeting and conference rooms equipped with closed circuit television will provide the latest instructional equipment for demonstrations, lectures and training sessions.

With the 110,000 people who visit M.S.U. campus each year in the interest of agriculture, it is estimated that 500,000 will visit the building annually. It is expected to attract key people from all parts of the world.

The new modern structure will be 300 ft wide and 240 ft long with a two story front section 300 ft by 60 ft. The exhibit area for large equipment will be 200 ft by 180 ft. Designated areas will be used for special interest exhibits such as transportation, irrigation and drainage, processes, materials handling, structures, power and machinery, fuels and lubricants, electric light and power, communications, household equipment, chemicals (agricultural and household), farm shop, and miscellaneous.

Exhibits are planned to be of an educational nature, showing principles of operation, materials and methods of construction, and systems, as well as showing models or actual equipment. The motif of the exhibits will be that of new ideas, new developments and new processes, rather than museum-like.

The agricultural engineering department of Michigan State University will operate the building and lease exhibit space, conduct tours, present demonstrations and develop interest in all exhibits. Exhibitors will keep the exhibits up to date and provide new items to maintain interest. Funds obtained from the leasing of exhibit space will be used to finance the building and its operation.

Long-Term Loans for Farm Equipment Firms

Commercial Discount Corporation, Chicago, has announced that it will embark on a program of offering long-term (5-year) capital financing to growth corporations in the farm equipment industry with a minimum of $100,000 and a maximum of $1,000,000 to any one company. Sidney Feuchtwanger, president, indicates that after one year of experimentation, the company has decided that long-term 5-year capital loans to growth companies in manufacturing and distributing are feasible and sound. The new program is said to differ from bank loans since the term is longer than any short-term bank commitment would allow. It will differ from underwriters' public stock issues by involving no share of ownership of profits in the growth company, or voice in management. This new type of long-term financing will be based on demonstrated earnings power rather than the value of fixed assets of the borrower, although the usual type of business loan collateral will be involved. The plan has been introduced to encourage expansion of smaller firms with good credit who find other long-term credit difficult to arrange.

Agricultural Engineering in ASEE Program

Three features are on the program for the Agricultural Engineering Division session in the Annual Meeting of the American Society for Engineering Education at Pittsburgh, Pa., June 14-19.

The agricultural engineering program is scheduled for Thursday afternoon, June 18, following a Division luncheon.

"A course in Land Location Mechanics," by E. T. Vincent, University of Michigan, is the opening item on the afternoon program. It will be followed by a presentation of "The Changing Place of the Laboratory in Engineering Education," by D. R. Hunt, Iowa State College. "The Gifted Student" is to be considered from two viewpoints. "Responsibilities of the College" will be discussed by J. W. Cohen, Director of the Inter-University Committee on the Superior Student. "Responsibilities of Industry" are to be presented by E. H. Case, Director of College and University Relations, Deere and

(Continued on page 159)


Paul J. Reeves


L. H. Hodges


R. R. Roth


C. E. Henson

Paul J. Reeves has been appointed vice-president in charge of sales for the Timken Roller Bearing Co., effective March 1. He joined the Timken Company in 1929 as a sales engineer and was made district manager of the Industrial Division's California branch in 1932. He became sales promotion manager in 1940 and from 1941 to 1943 he acted as manager of the Priorities Department. He was promoted to advertising manager in 1944 and director of sales in 1951, the position he held before becoming vice-president.

The following ASAE members have received promotions in the J. I. Case Company's Rockford, Illinois, Works. **L. H. Hodges** has been promoted to works manager, **R. R. Roth** is now chief product engineer, and **Clarence E. Henson** has been appointed assistant chief product engineer.

L. H. Hodges attended Texas A & M College where he received a B.S. degree in agricultural engineering and University of Wisconsin where he earned a B.S. degree in mechanical engineering. During World War II he served as an officer in the field artillery. He was promoted from assistant design and research engineer in 1952 to chief product engineer in 1955 and now will head one of the company's largest manufacturing operations.

R. R. Roth attended the University of Missouri where he received B.S. degrees in agricultural engineering in 1943 and mechanical engineering in 1947. He was promoted last year from product engineer in charge of harvesting division, to assistant chief product engineer, Rockford Works, and now assumes the post of chief product engineer.

C. E. Henson earned a B.S. degree in agricultural engineering from the University of Missouri in 1953. He joined J. I. Case Co., Rockford Works, in July 1954 as a design engineer and was given the post of product engineer of the Anniston, Alabama Works two years later. He was promoted the same year to assistant chief product engineer and chief tool engineer at the Burlington, Iowa, Works. In 1957 he was transferred to Rockford Works as division head in moldboard plow and deep tillage equipment division, the position he held at the time of his promotion to assistant chief product engineer of the Rockford Works.

George E. Womble, formerly product engineer at New Idea Division of Avco Mfg. Corp., Coldwater, Ohio, has been promoted to the position of engineering supervisor. He has been associated with New Idea since 1952 and is in charge of engineering design programs on several machines manufactured at New Idea's Ft. Dodge, Iowa, factory. He is also responsible for the company's new flail-type harvester-shredder.

Rush E. Choate, associate professor of agricultural engineering, University of Florida, has been appointed chairman of the University of Florida Agricultural Quadricentennial Committee. The committee will work out plans to coordinate exhibits to be displayed at Florida's Quadricentennial, a state-wide celebration which will last for seven years. The celebration will open this spring in Pensacola, closing in St. Augustine in 1965.

William O. Terrill, engineering representative with the Dayton Rubber Co., reports that he has been transferred from Chicago to Moline, Ill.

T. V. Martin, formerly sales engineer with the Spencer Mfg. Co., advises he now has his own business in Fort Collins, Colo., as a manufacturer's representative.

Richard W. Guest recently has been appointed extension agricultural engineer at Cornell University. Formerly he was graduate assistant in the agricultural engineering department at North Dakota Agricultural College. In his new position at Cornell he will divide his time equally between extension and research in the general area of materials handling equipment and methods.

L. W. Knapp, former extension agricultural engineer, Cornell University, is now located at the Institute of Agricultural Medicine, State University of Iowa, Iowa City, as head of the Accident Prevention and Conservation of Human Resources Section.

James A. Mullins, cotton ginning specialist and agricultural extension specialist, Agricultural Extension Service, Jackson, Tenn., has returned to his duties after an absence of over a year at which time he received an M.S. degree in agricultural engineering at Clemson Agricultural College, Clemson, S. C.

Norman C. Teter has recently been appointed to head the Cooperative Farm Building Plan Exchange Section of the Agricultural Engineering Research Division at Beltsville, Md. He has worked with Agricultural Research Service since 1952. Prior to that he served for 10 years with North Carolina State College as assistant and associate professor of agricultural engineering, respectively, following two years as an instructor at Iowa State College. He received a B.S. degree from the University of Missouri and an M.S. degree from Iowa State College, with a major in farm structures.

J. O. Curtis, assistant professor of agricultural engineering at the University of Illinois College of Agriculture, has been granted a Science Faculty Fellowship by the National Science Foundation.

This fellowship grant is for a period of 15 months and is one of about 300 awarded nation wide as a way to help improve the teaching of science in United States colleges and universities. The system of awards is planned to help science teachers study to become more effective instructors.

He plans to begin his fellowship program in September at Purdue University. His general field of study will be agricultural engineering with major emphasis on structural design and minors in statistics and heat transfer. In addition to fulfilling the major program objective of improving his effectiveness as a teacher, the course of study will also help him to satisfy the requirements for the Ph.D. degree.

He earned both his B.S. degree in agricultural engineering and his M.S. degree in civil engineering at the University of Illinois. He has been a member of the faculty in the department of agricultural engineering since 1948, except for two years of military leave during the Korean War. His present work includes both teaching and research in the field of farm structures. He is the second member of the department of agricultural engineering at the University of Illinois to receive a National Science Foundation Science Faculty Fellowship in the past year. Robert M. Peart began his Ph.D. program at Purdue in 1958.

Ralph W. Baird, project supervisor, Blackland Agricultural Experimental Station, Riesel, Texas, was named Central Texas Engineer of the Year by the Central Texas Chapter of Texas Society of Professional Engineers. He was presented with a plaque at a banquet February 23 certifying his honored position.

Mr. Baird was born in Kansas and received a B.S. degree from Kansas State College and an M.S. degree from Iowa State College. He moved to Texas in 1930 and aided in setting up the experiment station in 1935. He is a former president of the Central Texas Chapter of the Texas Society of Professional Engineers.

NECROLOGY

Howard E. Alverson, manager of the Southeastern Michigan Rural Electric Co-op, died from electrocution February 22, 1959, near Tecumseh, Mich., while repairing a power line damaged during an ice storm.

He was born September 18, 1912, in Pittsford, Mich., and graduated from the Sand Creek, Mich., high school. A veteran of World War II, he served in the U.S. Navy for eight years and was chief quartermaster when he was discharged. During his employment with Southern Michigan Rural Co-op, a position he held since 1949, he was active in statewide farm electrification work and a member of the Michigan Committee on Rural Electrification.

He was a member of the Adrian Kiwanis Club, the Chamber of Commerce, the William C. Stark Post of the American Legion, and he held membership in the First Church of Christ, Scientist. He is survived by his wife, Eleanor, and three daughters.

. . . Section News
(Continued from page 157)

Co. G. E. Pickard, University of Illinois, will preside.

Since this is a broad-interest program, it is expected to draw attendance from men in other branches of engineering, as well as agricultural engineers, to the limit of available space. The session has been scheduled for a room which will seat 100. Advance reservations will be favored as a basis for admission.

The Agricultural Engineering Division will also share in sponsoring a Monday morning joint Conference on "Teaching Electrical Engineering Service" courses for non-electrical students. A Friday interest feature for agricultural engineers is still in the making.

Frank B. Lanham, chairman of the Agricultural Engineering Division, arranged the Division program and will open it at the Thursday noon luncheon. The location and timing favor a capacity attendance by agricultural engineers on their way to the ASAE Annual Meeting at Cornell University the following week.

Nuclear Energy Institutes Planned

Six Summer Institutes on Nuclear Energy for engineering educators will be held throughout the nation this summer under the sponsorship of the Atomic Energy Commission and the American Society for Engineering Education. The purpose of the institutes is to provide special training in the fields of nuclear energy and the nature of nuclear reactor problems. The teachers then can incorporate the material in their teaching programs or teach new courses in the rapidly expanding nuclear programs of the country's colleges of engineering.

Five of the 1959 institutes are for teachers in colleges of engineering having curricula approved by the Engineers' Council for Professional Development. No special background in nuclear energy is required for the basic course.

This program of summer institutes reflects the continued need for such courses, first offered in the summer of 1956. The six 1959 institutes will provide instructional capacity for about 150 teachers. Attendees will be selected by subcommittees of the ASEE Nuclear Committee on the basis of the candidate's experience and the instructional use to be made of the training. Additional information may be obtained from W. Leighton Collins, Secretary, ASEE, University of Illinois, Urbana, Ill.

J. B. Wilson Elected to Grade of Fellow

John B. Wilson was elected to the grade of Fellow and to Life membership status, thereby becoming Life Fellow of ASAE. He was born in Albertville, Alabama, in 1887. He received a B.S.A. degree from Auburn Alabama Polytechnic Institute in 1919, in the same year accepting a teaching position in vocational agriculture in Madison County. In 1922 he was made principal of the State Secondary Agricultural School in Hamilton where he remained until 1927 when he joined the Alabama Agricultural Extension Service. As extension engineer he was successful in organizing soil conservation programs with county agents and farm leaders throughout the state of Alabama. He introduced and personally conducted widespread demonstration and leadership programs to introduce terracing and soil erosion control practices by the use of modern power machinery. In cooperation with the agricultural engineering department at A.P.I. and county agents, he organized county terracing associations which made it possible to develop an effective soil conservation program on a statewide basis. During the late thirties and until his retirement, he promoted the use of modern power machinery in southern farming practices.

Following World War II, he organized a state-wide land clearing and land reclamation program designed to adapt the rolling lands of the state to the use of modern power machinery. At the height of the program, there were over 150 farm power contractors in the state engaged in land clearing and land reclamation work.

After his retirement in 1949, he joined the Implement and Tractor Division of Ford Motor Co., serving as technical adviser on problems relating to the design, development and application of farm equipment for specific use in the South.

In 1934-35 he served as secretary of the Southeast Section and as chairman the following year. He helped organize the Alabama Section, serving as chairman of the first nominating and membership committees of the section. From 1949-50 he was vice-chairman of the Alabama Section and served as chairman in 1950-51. From 1944 until 1949 he served as secretary of the Alabama Farm Equipment Association.

J. O. Curtis (left), assistant professor of agricultural engineering at the University of Illinois College of Agriculture, reviews with William L. Everitt, Dean of the College of Engineering, the letter which notified him of his selection to receive a Science Faculty Fellowship from the Science Foundation. He is the second member of the department of agricultural engineering at the University of Illinois to receive a Science Foundation Fellowship in the past year (See page 158)

Agricultural Engineering Featured at Farmers' Week

Nearly 50,000 visitors attending Farmers' Week during the first week in February at Michigan State University had an opportunity to attend several meetings dealing with various agricultural engineering subjects and an extensive farm equipment and materials show. A special area devoted to agricultural engineering research featured mechanical cucumber harvesters, frost prevention by water spray, materials handling research equipment, experimental precision planters, new principles of threshing grain, and methods of utilizing thin plastic sheets in the construction of bubble-type buildings.

One of the high points of the week was the Third Annual Agricultural Engineering Farmers' Week Banquet. Keith Pfundstein of the Ethyl Corp. was toastmaster and John Strohm, world traveler and lecturer, was principal speaker. He showed colored movies and described agriculture behind "the bamboo curtain." In spite of bad weather approximately 250 attended the banquet, or more than double the 1958 attendance.

Materials Engineering Design Proceedings Available

Proceedings are now available for two short courses conducted during the past summer dealing with materials engineering design for high temperatures and mechanical properties of materials. These proceedings cover recent developments in two important fields of mechanics and materials by national authorities in the field. Copies can be obtained by writing to J. Marin, Department of Engineering Mechanics, The Pennsylvania State University, University Park, Pa.

EVENTS CALENDAR

March 23 — *American Society for Testing Materials,* Chicago District, will meet at Western Society of Engineers, 84 East Randolph St., Chicago, Ill., to discuss polar construction. Contact K. R. Parker, Joslyn Mfg. & Supply Co., 155 N. Wacker Dr., Chicago 6, Ill., for information.

April 5-10—*1959 Nuclear Congress,* Public Auditorium, Cleveland, Ohio, sponsored by Engineers Joint Council, 29 West 39th St., New York, N. Y.

April 5-16 — *First International Farmers Convention in Israel.* Write to Allied Travel Inc., 103 Park Ave., New York 17, N. Y.

April 7-10 — *40th Annual Convention and Welding Show* of the *American Welding Society,* Sherman Hotel, Chicago, Ill. For further information write to Arthur L. Phillips, Secretary, Information & Education, American Welding Society, Inc., 33 West 39th St., New York 18, N. Y.

April 29—May 1 — *Metals Engineering Conference* of the *American Society of Mechanical Engineers,* Albany, N. Y. For details contact L. S. Dennegar, Director of Public Relations, ASME, 29 West 39th St., New York 18, N. Y.

May 3-10 — *Soil Stewardship Week,* sponsored by the *National Assn. of Soil Conservation Districts.* For material write to Nolen J. Fugua, President, NASCD, P.O. Box 7, Duncan, Okla.

May 5-7 — *14th Purdue Industrial Waste Conference,* Purdue University. For details write Don E. Bloodgood, Purdue University, School of Civil Engineering, Lafayette, Ind.

May 7-9 — *First World Congress for Agronomic Research,* Headquarters of the FAO, Rome, Italy. Organized by the International Confederation of Agricultural Engineers and Technicians. For details contact The CITA Secretary's office, (1st World Congress of Agricultural Research), Beethovenstrasse 24, Zurich, Switzerland.

May 11-12—*Triennial Technical Conference* of the *U.S. National Committee* of the *International Commission on Irrigation and Drainage,* Reno, Nev. Information may be obtained from Stephen H. Poe, Executive Secretary, U.S. National Committee, ICID, Box 7826, Denver 15, Colo.

Iowa Section

The Iowa Section will hold a joint meeting with the Iowa Section of the American Society of Mechanical Engineers and the Waterloo Technical Society on April 10.

An afternoon technical meeting of two or three concurrent sessions will be held at the main plant of the John Deere Waterloo Tractor Works. J. L. Butt, executive secretary of ASAE, will be the feature speaker for the evening dinner meeting to be held at the John Deere Supervisor's Club.

Central Illinois Section

A combined open house and meeting has been arranged by the Central Illinois Section for its Spring Meeting to be held April 1. Scheduled on the eve of the College of Agriculture Farm and Home Festival, the meeting will give members an opportunity to preview exhibits being readied for the festival.

An informal open house in the department of agricultural engineering, Agricultural Engineering Building, is being planned for 4:00 to 6:00 p.m. Dinner meeting will be at the University YMCA, 801 S. Wright St., Champaign. Dr. E. G. McKibben, director, AERD, ARS, USDA, and ASAE president, will give an address at 7:30 p.m.

Mid-Central Section

The Mid-Central Section will meet in the Robidoux Hotel in St. Joseph, Mo., April 3-4. Registration will begin at 10:30 Friday a.m., April 3, with Gerald Kline, secretary-treasurer of the Section in charge.

D. R. Hunt, vice-chairman, will preside at the afternoon program which will open with a panel on small watershed activities with J. C. Steele, University of Nebraska, as moderator. A second panel which considers the state farm electric program will follow, with R. M. George as moderator.

Dr. E. G. McKibben, director AERD, ARS, USDA, and president of ASAE, will be the speaker at the Section Banquet Friday evening.

Papers to be presented at the Saturday morning session include discussions on plastics and their properties, simplified machinery design, Midwest plan service activities, farm concrete tilt-up construction, and effect of drying temperature on the nutritive value of grains.

The afternoon program will feature Fred Fenton, Kansas State College, who will address the members on the subject, "India As I Saw It."

Pennsylvania Section

The Pennsylvania Section will hold its spring meeting on April 10 at Hetzel Union Building Auditorium, Pennsylvania State University campus. Topics will include formal education after graduation; harvesting, handling, storing shelled corn; and engineering and agronomical aspects of soil compaction. A noon luncheon and an evening banquet are being planned.

BULLETIN

The Tennessee Section has earned the distinction of being the first to reach its quota for the Motion Picture fund. The Ohio and Quad City Sections have sent in partial payments toward their quota and indications show that others are working on fund raising plans for their part in behalf of the Motion Picture project.

Commitments for purchasing copies of the film have been made by the University of Arkansas, the University of Illinois, Oklahoma State University and Michigan State University, in meeting quotas established for colleges and universities.

Pacific Coast Section

The 37th Annual Meeting of the Pacific Coast Section was held at Asilomar, Pacific Grove, Calif., February 4-5. The nominating committee reported the following names for officers of the Section for the ensuing year: chairman, A. F. Pillsbury; vice-chairman, M. V. Johnson, Jr.; secretary-treasurer, R. G. Curley; elected member, executive committee, T. E. Bond; nominating committee, J. F. Merson (chairman), M. R. Parsons, and P. R. Bunnell.

L. H. Lamouria who presided at the meeting reported that the public relations committee has acquired the names of more than 100 agricultural engineers in the Pacific Coast Section territory who should be ASAE members, and that these names were being processed and within a short time each of these will be contacted personally.

During the Annual Banquet, Walter W. Weir who has been secretary-treasurer of the Pacific Coast Section for 30 years until his recent retirement, was honored. He was presented with a plaque from the Section which read: "To Walter Weir, in appreciation of 30 years service as secretary-treasurer of the Pacific Coast Section. Presented at the 37th Annual Meeting, American Society of Agricultural Engineers, February 4, 1959." During the ceremony, with R. Earl Storie acting as master of ceremonies, Lloyd Brown presented Walter with a silver loving cup; J. P. Fairbank expressed words of appreciation and presented him with a drainage system consisting of a tin drainage basin and sponge for draining out the excess water; and Leonard Fletcher, past-president of ASAE and second chairman of the Pacific Coast Section, presented him with an automatic projector from the members of the Section. He received many letters from the past officers and members of the Section expressing their appreciation of his good work in behalf of the Society. Presentation of the plaque was made by L. H. Lamouria, chairman of the Section.

ASAE MEETINGS CALENDAR

April 1—CENTRAL ILLINOIS SECTION, University of Illinois, Urbana.

April 3-4 — MID-CENTRAL SECTION, Hotel Robidoux, St. Joseph, Mo.

April 10 — PENNSYLVANIA SECTION, Hetzel Union Building Auditorium, Pennsylvania State University.

April 10 — Joint meeting of the IOWA SECTION, Iowa Section of the American Society of Mechanical Engineers and the Waterloo Technical Society, John Deere Waterloo Tractor Works, Waterloo, Ia.

April 10-11 — Joint meeting of the Michigan and Ohio Sections, Secor Hotel, Toledo, Ohio.

April 16-18 — FLORIDA SECTION, George Washington Hotel, West Palm Beach, Fla.

April 23-24 — ALABAMA SECTION, Anniston, Ala.

JUNE 21-24 — 52ND ANNUAL MEETING, Cornell University, Ithaca, N. Y.

September 1-3 — NORTH ATLANTIC SECTION, University of Maryland, College Park, Md.

October 14-17 — PACIFIC NORTHWEST SECTION, Ephrata, Wash.

October 21-22 — Alabama Section, Enterprise, Ala.

December 16-18 — WINTER MEETING, Palmer House, Chicago, Ill.

NOTE: Information on the above meetings, including copies of programs, etc., will be sent on request to ASAE, St. Joseph, Mich.

Walter W. Weir Honored

Walter W. Weir proudly displays a plaque and loving cup presented to him in appreciation of 30 years service as secretary-treasurer of the Pacific Coast Section of ASAE. Presentation was made during the 37th Annual Meeting of the Section, February 5 at Asilomar, Pacific Grove, Calif.

It's easy to design with concrete

Quality construction for buildings of all types is based on simple design principles. Observance of these fundamental principles is the sure way to economical, attractive and durable farm structures.

This is the first in a series of reports that will show accepted design methods for concrete. Each will deal with one specific aspect of concrete construction, and the application of engineering principles.

Foundations . . . "a job well begun is half done"

Type: *Continuous foundations* are the most economical way to assure protection of the building contents from rodent damage. On small farm buildings continuous foundations are designed by "rule of thumb." The footing is made twice as wide as the wall thickness and of a depth equal to the wall thickness.

Spread footings are economical where the loads can be carried by columns or frames. Small spread footings are made half as thick as the side dimension of the footing.

Post and grade beam foundations are economical, in areas of extreme frost penetration. The post is designed to carry the entire load in end bearing on the soil. Frictional resistance of the soil on the post cannot be relied on.

Grade beams are designed as continuous members to carry loads to the posts. Moment is considered to be $1/12\ wl^2$. Since the beam does not extend below the frost line, stress reversals in the beams are likely to occur due to frost heave. The beam is reinforced for equal moment in both directions.

Size: The bearing value of the soil determines the foundation area needed. Test borings are the only sure way of determining actual foundation capacities. Farm structure designs are usually based on presumed bearing capacities for different soil types. Fig. 1 shows the range of bearing values commonly used. Knowing the load on the footing and the bearing capacity of the soil the size footing can be determined from solid lines on chart.

Depth: Foundations should always extend below the frost line. Shallow or floating foundations, as the name implies, are subject to movement. Soils that have thawed after freezing are often quite fluid and have poor bearing qualities. Frost heave is particularly serious with some soils, notably silts and loams.

Reinforcement: Continuous foundations for farm buildings need not be reinforced except in areas of unusual soil conditions. If reinforcement is used to control cracking, an area of steel equal to at least 0.0025 times the cross sectional area of the foundation should be used longitudinally. It should be equally distributed between top and bottom of the foundation wall.

Isolated footings smaller than 3 feet square are usually unreinforced. For larger footings the amount of reinforcing needed in each direction can be determined from the dotted lines of Figure 1, shown above.

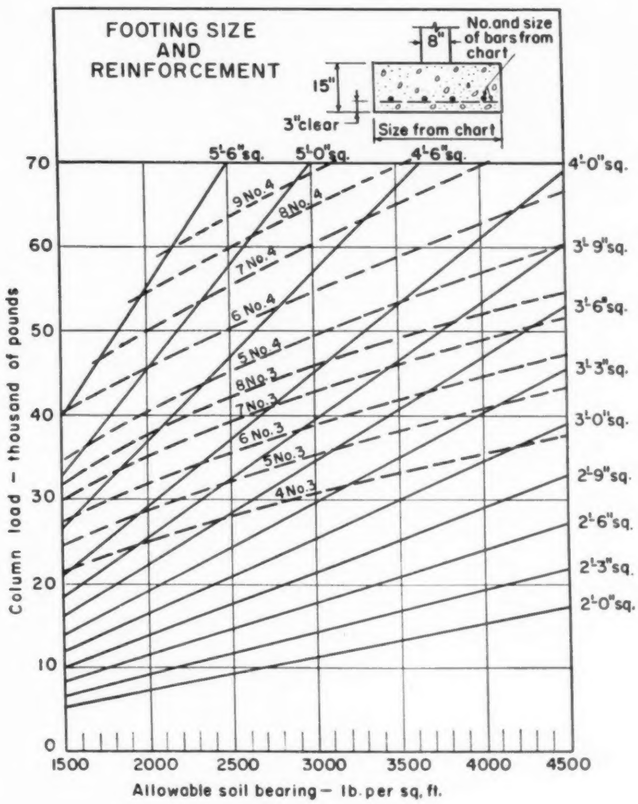


FIG. 1

Example: Assumed bearing capacity of soil = 4,000 p.s.f.
Assumed Column Load = 45,000 lb.
From Fig. 1: 3'6" sq. footing
From Fig. 1: Seven No. 3 (3/8" round) bars each way.

For more information on actual construction methods, write for free booklet, "*Building Concrete Farm Structures.*" Distributed only in the U.S. and Canada.

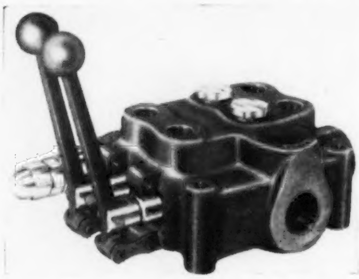
PORTLAND CEMENT ASSOCIATION

Dept. A3-1, 33 West Grand Ave., Chicago 10, Illinois

A national organization to improve and extend the uses of concrete

Hydraulic Control Valve

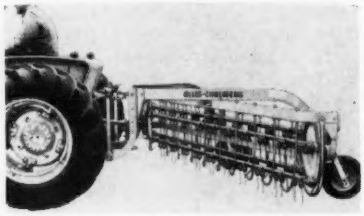
Gresen Mfg. Co., 405 35th Ave. N.E., Minneapolis 18, Minn., announces a new model 40-gpm Gresen control valve for



heavy-duty mobile use. Rated at 40 gpm, at 20 fps, the new valve is said to operate easily at pressures up to its maximum of 1500 psi. It is adaptable to various hydraulic control systems particularly those on industrial mobile equipment. Standard models are open-center types with choice of 3-way or 4-way spools. They have a 1-in. side inlet, 1¼-in. side outlet, and ¾-in. cylinder ports. Available modifications include closed centers, detents, free flow, and "power beyond" porting to permit a wide variety of circuit applications.

Parallel Bar Rake

Allis-Chalmers Mfg. Co., Milwaukee, Wis., announces a new parallel-bar fully-mounted rake for convenient handling and



working close to fences, in corners or along levees. The reel is driven by a V belt from the power take-off, and ground and reel speeds are co-ordinated to rake fast and clean. The staggered location of two rubber-tired caster wheels is said to assist the operator in controlling the rake and to carry the reel safely over rough ground. A double-arch, channel-steel frame forms the backbone of the machine, and disk-type reel ends of sturdy construction prevent catching the hay. The hubs run on tapered roller bearings and the reel operates on large, sealed ball bearings. The rake has only seven grease fittings.

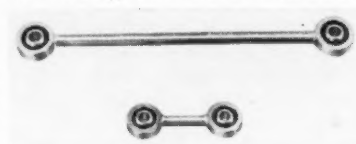
New Wheatland Tractors

The Oliver Corp., 400 W. Madison St., Chicago 6, Ill., announces new wheatland tractors in two sizes developed for grain and rice farming operations. A low center of gravity and wide wheel treads have been provided in both models to give stability on rolling and hilly terrain. Belt horsepower ratings are 64 and 51 hp for the 880 and 770 models, respectively, and they are adapted to use diesel, LP gas or gasoline fuel. These tractors have short wheel bases, 83 and 81$^{15}/_{16}$ in., respectively, to provide maximum maneuverability. A heavy-duty wide swinging drawbar which pivots ahead of the rear axle is provided to facilitate turning under heavy loads. An arched,

industrial-type axle bed with a total oscillating range of 36 deg gives these tractors additional front-end crop clearance. The tractors can be driven over obstructions as high as 16 in. Power steering is available as optional equipment.

Self-Contained Control Rod

Carter Engineering Co., Ferrysburg, Mich., announces its new "Alinabal" control rod assembly, a self-contained control-rod



assembly that is said to offer improved design and savings in cost to the user. The

(Continued on page 164)

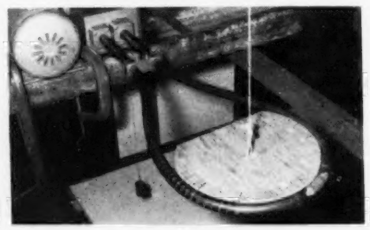
. . . New Products

(Continued from page 162)

company reports that less material is required than for a conventional two rod-end assembly plus reduced machining costs. Advantages claimed for this product include all parts highly corrosion resistant, simplified design, self-lubricated, suitable for high or low-velocity applications, controlled fit and clearance between ball and spherical race, and full race curvature with load applied to center of ball as in accepted ball-bearing construction. Special advantages are reported for applications where a fixed, non-adjustable center distance between joints can be used.

High-Speed Power Drive Shaft

Stow Mfg. Co., 310 Shear St., Binghamton, N. Y., announces a new rubber-covered, high-speed, power-drive flexible shaft, rec-



ommended for use in transmitting power at speeds of two to three times the maximum speed recommended for the company's standard ball-bearing flexible shaft. The new power-drive shaft has a tight-wound, precision-made flexible shaft core and high-quality ball bearings at each end. The couplings on each end are bored to fit the particular application. The new shaft is available in three sizes of 3/8, 1/2, and 5/8 in. for recommended speeds of 6900 rpm for the two smaller sizes, and 5750 rpm for the large size.

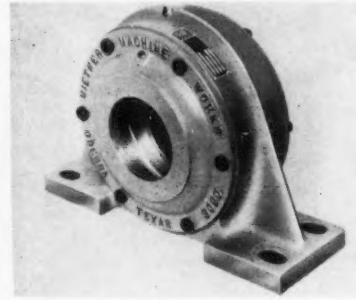
Hay Conditioner

New Idea Farm Equipment Co., Coldwater, Ohio, announces a new hay conditioner, said to provide uniform crushing

action, wrap and plug-free performance and good fluffing action. This product combines a fluted steel pickup roll with a large resilient rubber roll for feeding and crushing. The combination of one rubber and one steel roll, operating at high speed, reportedly fluffs the gently crushed hay, leaving it in a loose condition for faster drying. A chain drive, protected by a friction-type slip clutch, operates both upper and lower rolls. Proper wheel placement balances the machine for easy one-man hook-up. A mower hitch is available as optional equipment for operating the conditioner with a semi-mounted mower.

Pillow Blocks

Miether Machine Works, P.O. Box 3907, Odessa, Tex., announces a new line of pillow blocks to accommodate all series of spherical roller bearings. By means of interchangeable end caps, 20 basic housings in this line reportedly will accommodate 94 separate bearings. Some housings take as many as eight different bearing sizes and up to 11 separate shaft diameters. The hous-



ings are center-grooved for universal center lubrication, and end caps have a second connection for side lubrication. A 1-piece housing features a reinforcing center rib to withstand severe shock loads. Bases are precision machined on both ends and bottom surfaces to facilitate correct blocking and to retain alignment.

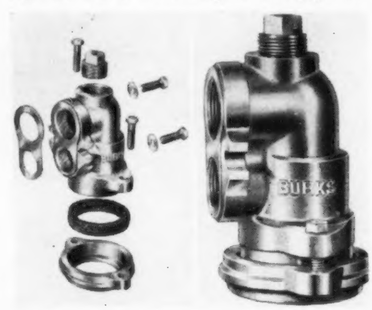
Soil Tester

The Kel Engineering and Equipment Co., 11 Cambridge Lane, New Brunswick, N. J., announces development of a new type soil

tester that measures the Ph value of the soil as well as the moisture content. The tester is 6½ in. long and weighs 8 oz. It is carried in a leather case that can be attached to one's belt. In use, the tester is placed vertically in the soil, and the acidity or alkaline value is instantly indicated on the upper part of the meter.

Well Cap for One-Pipe Jet Pumps

Decatur Pump Co., 2750 Nelson Park Rd., Decatur, Ill., announces the new Burks well cap for off-set mounting of one-pipe jet



pumps on 2-in. well. This offset design well cap eliminates the use of elbows, tees, and nipples on offset installations, and is said to speed hook-up and provide a safe, sanitary seal. Body and packing gland are of heavy-cast gray iron, the prime plug is of brass, the packing is a blend of flax fiber and jute, and the capscrews are rust-proof. The device is suited for offset installations when the pump is located some distance from the well, and will accommodate pumps with 1¼-in. suction and 1-in. pressure connections.

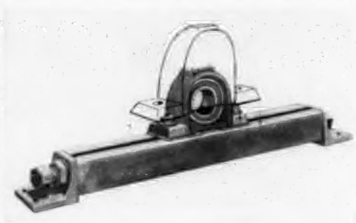
(Continued on page 166)

. . . New Products

(Continued from page 164)

Take-up Frame For Pillow Block

Lovejoy Flexible Coupling Co., 4927 W. Lake St., Chicago 44, Ill., announces a new take-up frame said to permit use of any



pillow block with one basic frame size. The frame can be top or side mounted. A wide range of sizes and travel lengths from 2 to 36 in. are available and reportedly will accommodate any type or make of pillow block from ½ to 2$\frac{7}{16}$ in.

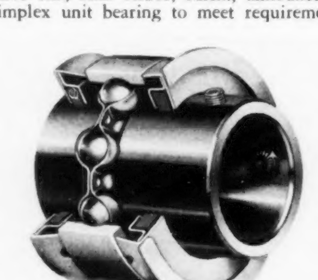
New Sprayer Strainer

Spraying Systems Co., 3226 Randolph St., Bellwood, Ill. has introduced a new suction strainer for use on sprayer rigs said to pro-

vide a 75 percent greater open screen area than previous models. It is designed for application where a large volume of liquid per minute is to be sprayed or where the user wishes to reduce possibility of clogging as well as pressure loss through the strainer to a minimum. It can be attached to an intake hose through hose shank connection for immersion in tank or drum and will pass through a standard steel-drum bung hole. The strainer can be easily disassembled for cleaning merely by turning a knurled screw which releases all parts, without the use of tools.

Simplex Machine Unit Bearing

Hoover Ball and Bearing Co., 5400 S. State Rd., Ann Arbor, Mich., announces a simplex unit bearing to meet requirements



of many applications. It is designed for light loads at normal speeds and includes a single-row bearing of deep-groove design with extended inner ring equipped with two setscrews for locking the bearing on the shaft. Separable seals may be used either singly or on both sides of the bearing. A wire-lock ring holds the entire unit in its straight bore housing. Bearings are available in shaft sizes from ½ through 1$\frac{3}{16}$ in. Product Data Bulletin No. 3 provides complete dimensional and load data for the new unit.

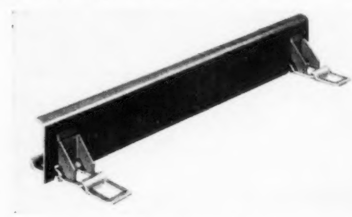
Hydraulic Tool-Bar Carrier

International Harvester Co., 180 N. Michigan Ave., Chicago, Ill., announces a new tool-bar carrier equipped for hydraulic control for power requirements ranging from 40 to 65 hp. The carrier can be equipped with a heavy-duty rectangular tool bar or the regular square tool bar. Special attaching angles also provide for use of

chisel shanks and middlebusters to permit performing a wide variety of tillage operations. The tool-bar carrier features an adjustable hitch that allows the frame to run level for any working depth of various implements and tractor drawbar heights. A double-acting hydraulic cylinder attachment is provided for raising and lowering the carrier.

Positive Lock Flight

Chain Belt Co., Agricultural Chain Div., Dolton, Ill., announces a new development in agricultural chain conveyor flights called "positive lock flight." This feature is a raised projection which immediately borders the top edge of the chain attachment on the



trailing side of the flight. The projection is formed by blanking and prevents the chain attachment from turning on the flight, thereby insuring that the flight bar and chain will always be correctly positioned to carry ultimate loads.

Pre-Emergent Spray Kit

Tryco Mfg. Co., 1600 N. Calhoun St., Decatur, Ill., announces a pre-emergent spray kit said to fit all row-crop planters for spraying materials in a band on the crop rows at the time seed is planted. The kit consists of special mounting brackets that will fit any planter and adjust to any angle

to give the proper spray pattern with nozzle tips. The kit also includes a stainless steel line strainer, hoses, clamps and all necessary fittings. A variety of kits are available for 2, 4, and 6-row planters and they are designed for use with presently owned spray equipment, or components can be purchased to complete the unit.

(Continued on page 173)

• The manufacturers of most American cars, trucks, tractors and farm equipment have long specified Cleveland Graphite Bronze bearings, bushings and washers as standard. The same holds true in diesel and marine engines, household appliances, machinery and electrical equipment. Here are two good reasons why . . .

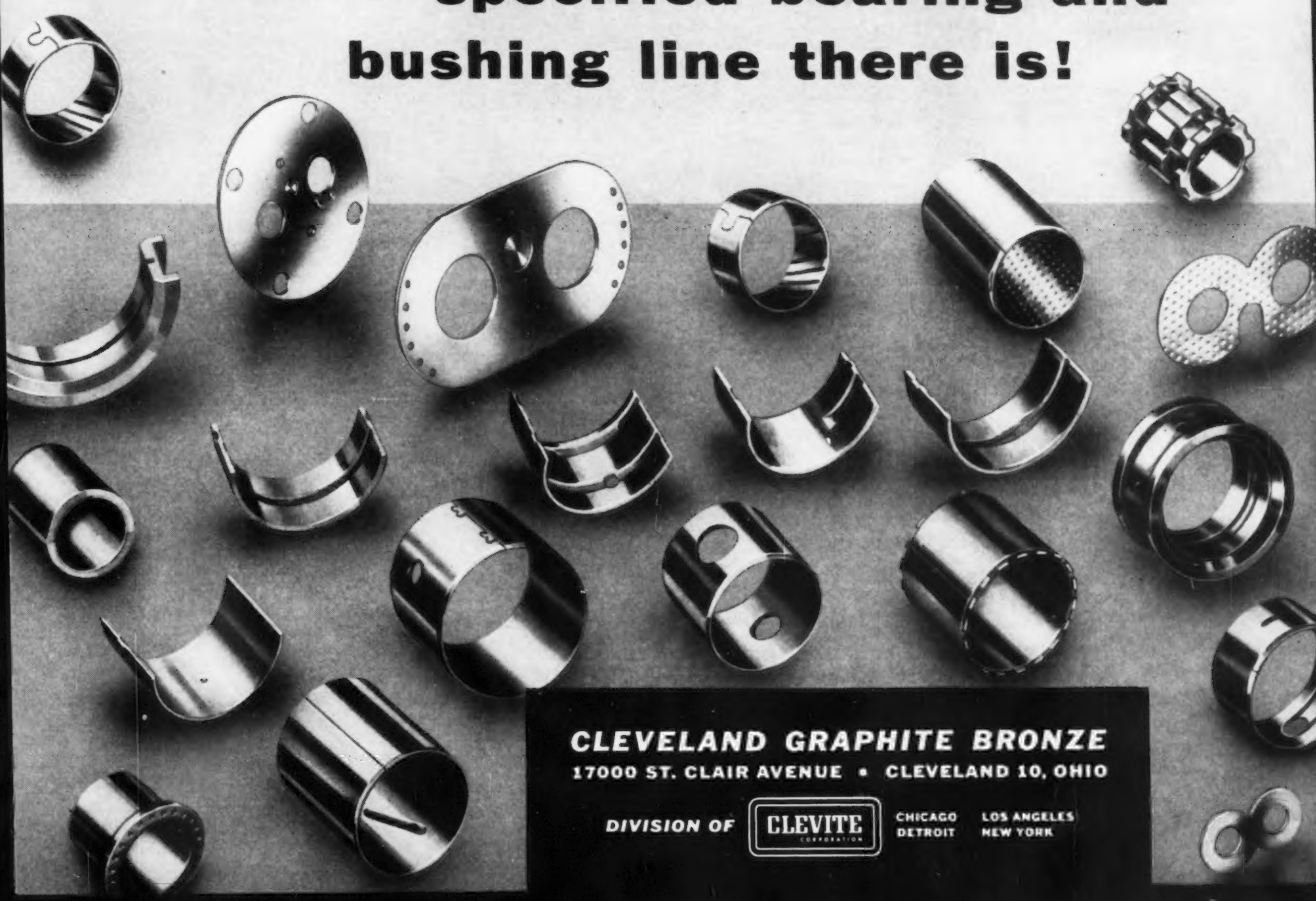
CGB has consistently pioneered in bearing and bushing design having designed and introduced the majority of types now in general use. The first rolled bronze bushing—the complex trimetallic flanged bearing are developments that prove the long span of this engineering and metallurgical leadership.

Advanced and unique manufacturing techniques including the development of strip mills for continuously casting molten babbitt metal or molten copper-lead on steel strip is again indicative of our leadership.

These are just two of many reasons why it will pay you to consider Cleveland Graphite Bronze bearings, bushings or washers before you specify.

Want specific data? Just write, wire or phone and a qualified engineer will be glad to work with you.

Here's the most specified bearing and bushing line there is!



CLEVELAND GRAPHITE BRONZE

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DIVISION OF CLEVITE CORPORATION

CHICAGO DETROIT LOS ANGELES NEW YORK

Following are brief reviews of papers presented at ASAE meetings or other agricultural engineering papers of which complete copies are available. ASAE members may obtain copies of these papers without charge by returning order forms supplied upon payment of membership dues. Nonmembers, and members requesting more than 10 copies, may purchase papers at 50 cents each to cover carrying charges from the American Society of Agricultural Engineers, St. Joseph, Mich.

The Effect of Crack Width at Tile Joints on Soil Movement Into Drain Tile Lines, by Benjamin A. Jones, Jr., assistant professor, agricultural engineering, University of Illinois, Urbana. Paper presented at the Winter Meeting of ASAE in Chicago, December 1958, on a program arranged by the Soil and Water Division. Paper No. **58-508.**

The object of the study described in this paper was to develop a laboratory procedure to determine the effect of the crack width at tile joints on the quantity of soil moved into tile drains. Different soils were used under various flow conditions. The tests were made using a 2-in. inside and a 2½-in. outside diameter tube packed in the center of a soil profile tank. Three sizes of crack widths were used and tested with a sandy loam, a silt loam, and a silty clay loam soil.

Evaporation Losses From Standard Non-Recording Rain Gages, by Edward M. Norum and Curtis L. Larson, respectively, assistant project engineer, Agricultural Experiment Station, Hawaiian Sugar Planters Association, and associate professor of agricultural engineering, University of Minnesota. Paper No. **58-519.**

Daily measurements during the first half of July at St. Paul, Minn., indicated that the average evaporation loss from a standard 8-in. gage was about 0.01 in. in three days. Measurements were continued into October and two methods of reducing the loss were studied: *(a)* A sheet metal shade 15 in. in diameter mounted concentrically around the gage and *(b)* A film of hexadecanol within the measuring tube. Losses from the various gages were correlated with temperature measurements over the range of 45 to 80 F. The following regression equation was obtained for the standard gage: $L = 0.001\ (0.001\ T - 4.39)$. Where L is the daily evaporation loss in inches and T is the mean temperature for the day. Corresponding equations were obtained for the other gages. At 75 F., the hexadecanol reduced the evaporation loss 26 percent and the shade reduced the loss by 41 percent.

2400 Hogs a Year Under Confinement, by Albert E. Powell, senior agricultural engineer, Douglas Fir Plywood Association, Tacoma, Wash. Paper presented at the Winter Meeting of ASAE in Chicago, December 1958, on a program arranged jointly by the Farm Structures and Electric Power and Processing Divisions. Paper No. **58-716.**

This paper describes a cooperative project which resulted in the establishment of a modern pork production plant. This plant was planned in 1956 and put into operation in January 1957, surpassing design capacity production in 1958. It was designed to fit a full confinement system of management in which the requirements of the animals during the various stages of growth were met with buildings and equipment tailored to fill those requirements. The author states that although some problems as yet remain to be solved, the plant has been successful. In 1958 it produced over 600,000 lb of live pork with less than one man-hour of labor for each 200 lb of pork produced.

Minimum Tillage in Illinois, by Wendell Bowers and H. P. Bateman, assistant professors of agricultural engineering, University of Illinois. Paper presented at the Winter Meeting of ASAE in Chicago, December 1958, on a program arranged by the Power and Machinery Division. Paper No. **58-619.**

The primary objective of this study was to compare corn populations and yields by various minimum tillage methods with those obtained by conventional procedures. Altogether more than 100 comparisons have been made, and 50 of those with replicated yield checks were selected for discussion in this report. Both population and yield obtained with minimum tillage are compared on a percentage basis with conventional results. The author concludes the report by stating that if future research can find a way to combine the early growth advantage of a conventionally prepared seedbed with the apparent late season benefits of minimum tillage, it may not be unreasonable to expect increased yields particularly in fine-textured or clay soils.

Infiltration Estimates Based Upon Vegetation and the Soil Profile, by H. N. Holtan, hydraulic engineer in the Watershed Technology Research Branch, Soil and Water Conservation Research Division, Agricultural Research Service, Beltsville, Md. Paper presented at the Winter Meeting of ASAE in Chicago, December 1958, on a program arranged by the Soil and Water Division. Paper No. **58-518.**

This paper considers infiltration in two parts: The initial volume accruing in the upper horizons at diminishing rates, and the final constant rate associated with the restricting horizon of a given soil. The initial volume is computed as the total of available porosity in those horizons lying above the restricting layer, modified by a vegetative factor as an index of the efficiency of distribution of infiltrated water to this porosity. This approach permits comparison of a volume, estimated as a finite quantity, with known features of the soil. It places a ceiling on the error of estimate. Time distribution of the initial volume is computed on the demonstrated premise that the rate of infiltration diminishes as a function of volume exhaustion, tangential to the final constant rate.

Results of Research on Plow-Plant Equipment Designed for Corn Production, by C. M. Hansen, L. S. Robertson and B. Grigsby, respectively, assistant professor, agricultural engineering dept.; assistant professor, soil science dept., and professor, botany dept., Michigan State University, East Lansing, on a program arranged by the Power and Machinery Division. Paper No. **58-616.**

This is a report involving a one-row corn planter unit, fitted with a herbicide applicator, mounted on the right side of a 4-wheeled tractor and operated while pulling a three 14-in. bottom plow. This "plow-

plant" method of growing corn reduced fuel and horsepower hours per acre to less than one-half that required by the conventional practices. The average yields from several locations was 10.9 bu. per acre in favor of the plow-planter. The minimum tillage practice of planting corn in press wheel or tractor tracks soon after plowing with a light smoothing tool behind the plow produced yields which compared favorably with plow-planting. Minimum tillage, however, required about one-fourth more fuel and power per acre when the herbicide was applied in separate operation and one cultivation was used.

Factors Affecting the Pelleting of Hay, by J. L. Butler and H. F. McColly, respectively, assistant agricultural engineer, Georgia experiment Station, and professor of agricultural engineering, Michigan State University. Paper presented at the Winter Meeting of the American Society of Agricultural Engineers, in Chicago, December 1958, on a program arranged by the Electric Power and Processing Division. Paper No. **58-806.**

Compressing hay into pellets or wafers appears to be a way of changing the physical form of hay so that complete mechanization of hay handling from the windrow to the feed bunk may be attained, and at the same time allow more efficient utlization of transportation and storage facilities. Before a machine to perform this operation can be efficiently designed, the effects of the many variables encountered in the pelleting operation should be determined. The investigation reported in this paper was undertaken to determine the effects of some of these variables.

A Radiation Sensitive Brooder Control, by Gerald M. White and John G. Taylor, respectively, graduate research assistant, department of agricultural engineering, Purdue University and formerly agricultural engineer, Farm Electrification Research Laboratory, AERD, ARS, USDA (deceased). Paper presented at the Winter Meeting of ASAE, Chicago, December 1958, on a program arranged by the Electric Power and Processing Division. Paper No. **58-801.**

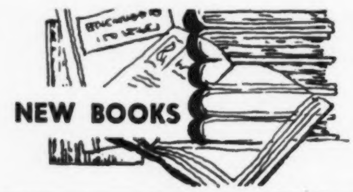
A control which has been developed at Purdue University to regulate the radiant energy level in infrared chicken brooders is described in this paper. This control is responsive to radiation and convection as well as to the brooder air temperature. The primary advantage claimed for this instrument is that it is sensitive to heat transfer beneath the brooder by radiation and convection as well as to the brooder air temperature; whereas, most conventional thermostats are primarily sensitive to air temperature alone.

Effect of Misalignment on Capacity of Tile Flowing Full, by H. P. Johnson, research associate, agricultural engineering department, Iowa State College, Ames. Presented at the Winter Meeting of ASAE, December 1958, on a program arranged by the Soil and Water Division. Paper No. **58-507.**

Laboratory tests described in this manuscript were conducted on model tile to determine the effect of different degrees of misalignment and length-to-diameter ratios on the capacity of tile. Tests were made through a range of Reynolds number of 3.5×10^4 to 2.5×10^5 for misalignments of 3.2, 6.0, 8.8 and 14.7 percent of the diameter and for length-to-diameter ratios of 1.3, 2.6, and 5.2. In summarizing the tests, the author states that observations indicated that the mean value of a series of measured misalignments will result in the same resistance to flow at the same Reynolds number as a constant misalignment of the same magnitude as the mean.

Environmental Studies With Early-Weaned Pigs, by A. J. Muehling and A. H. Jensen, respectively, research associate, department of agricultural engineering, and assistant professor, department of animal science, University of Illinois, Urbana. Paper presented at the Winter Meeting of ASAE in Chicago, December 1958, on a program arranged by the Farm Structures Division. Paper No. **58-710.**

Basic environmental work related in this paper was conducted in a controlled chamber. Pigs were weaned at two weeks of age and raised for three weeks on a dry, complete ration in a chamber at controlled conditions. Four pigs were put into each of eight 4 by 5-ft pens and different types of supplementary heat were studied. Measurements were taken of body weight and gain, feed consumption and conversion rates, body and skin temperatures, and the power consumed by heating units. A summary of all data made during the tests is included in the paper.



Farm Tractor Maintenance, by Arlen D. Brown and I. G. Morrison, second edition. Cloth, 5¼ x 8½ inches, 215 pages, indexed and illustrated. Published by The Interstate Printers and Publishers, 19-27 North Jackson St., Danville, Ill. $3.50.

This edition, designed to serve as a handbook and textbook, places emphasis on preventive maintenance of tractors. It is written for use by farmers, students and teachers, with the hope of preventing unnecessary repairs. Sections include chapters on preventive maintenance procedures, maintenance through careful operation, trouble-shooting, and tractor storage.

Resource Training for Business, Industry, Government. Cloth, 5¾ x 8¾ inches, ix+159 pages, indexed and illustrated. Published by the Conservation Foundation, 20 East 40th St., New York, N. Y.

This book is written to present the thinking of a number of people concerned with conservation and conservation education. It attempts to give concrete and vivid answers to the questions, Where does resource training stand today? How did it get there? Where is it heading in the future? It is intended to give its readers some understanding of the problems involved in a modern approach to conservation and conservation education, and of the way workers in the field are currently attacking these problems.

Knocking Characteristics of Pure Hydrocarbons. Cloth, 8¾ x 11¼ inches, iv +96 pages, indexed. Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. $6.00 (to ASTM members, $4.80).

This volume, ASTM Special Technical Publication No. 225, contains a history of API Research Project 45, a description of test methods, discussions of data in the tables, knock-test data of pure hydrocarbons, correlation of knocking characteristics with molecular structure, and properties of compounds tested. Knock-test data of pure hydrocarbons are presented in terms of ASTM octane numbers, critical compression ratios, 17.6 supercharged ratings, legend and examples of nomenclature.

Professional Income of Engineers — 1958, the Engineers Joint Council report. Engineers Manpower Commission, Engineers Joint Council, 29 West 39 St., New York 18, N. Y. $3.00.

A comprehensive report which includes data on 190,200 engineers employed in industry (155,000), government (federal 18,000—states and local 11,500) and engineering education (5,700). The data is presented in 42 tables including 23 industrial breakdowns, 3 government and 8 on engineering education. The report includes tabular presentations of data on 15,000 engineers with M.S. degrees and 4,000 with Ph.D. degrees. Also included are an age analysis of engineers in the U.S. and a comparative analysis of trends in engineering income since 1953.

Vinyl Resins, by W. Mayo Smith. Cloth, 5¼ x 7½, VII + 282 pages, illustrated and indexed. Published by Reinhold Publishing Corp., 430 Park Avenue, New York 22, N. Y. $5.75.

This book surveys the applications of vinyl resins against background information on their types, properties, chemistry, manufacture and fabrication. It covers recent advances in the vinyl field and includes new polyvinyl chloride "pearls" and Delrin resin. The treatment of polymerization systems for vinyl chloride is developed in considerable detail. Many items expected to show unusual growth such as vinyl laminates, rigids, foamed material and latex paints are brought into focus. The book contains practical information pertinent to manufacturers, fabricators, and market developers.

The National Fire Codes, Vol. IV, Extinguishing Equipment, 1958. Cloth, 5¾ x 8¾ inches, 1131 pages, indexed. For copies contact National Fire Protection Association, International, Executive Office: 60 Batterymarch St., Boston 10, Mass.

This volume contains a compilation of standards developed by the National Fire Protection Association and are used as a basis of good practice by property owners and others, and for legal and insurance purposes, in the United States, Canada, and other countries.

Effect of Surface on the Behaviour of Metals. Cloth, 5¾ x 8¾ inches, vii+100 pages, illustrated. Published by Philosophical Library, Inc., 15 E. 40th St., New York 15, N. Y. $10.00.

This volume contains the complete papers delivered at the Institute of Metallurgists Refresher Course held in 1957. Lecture titles are: Methods of Preparation and Examination of Surfaces; Influence of Surface Treatments on Chemical Behaviour of Metals; Relationship Between Surface Condition, Friction and Wear; and Influence of Surface on the Physical Properties of Metals.

The following bulletins have been released recently. Copies may be obtained by writing to author or institution listed with each.

Hydraulics of Closed Conduit Spillways: Part I. Theory and Its Application, by Fred W. Blaisdell, Technical Paper No. 12, Series B, January 1952 (revised February 1958) 22 pages. 80 cents.

Parts II through VII (combined). Results of Tests on Several Forms of the Spillway, by Fred W. Blaisdell, Technical Paper No. 18, Series B, March 1958, 50 pages. $1.50.

Part VIII, Miscellaneous Laboratory Tests and Part IX, Field Tests, by Fred W. Blaisdell, Technical Paper No. 19, Series B, March 1958, 54 pages. $1.50.

Part X. The Hood Inlet, by Fred W. Blaisdell and Charles A. Donnelly, Technical Paper No. 20, Series B, April 1958, 41 pages. $1.00.

Order from University of Minnesota, St. Anthony Falls Laboratory, Minneapolis, Minn.

Apromag Betakaritas AC-400 Tipusu Aratocseplogeppel *(Gathering in of Small Corn by Means of Harvester-Thresher Combine Type AC-400),* by Csaba Melykuti. No. 3 1957, with summary in English, and a Hibridkukorica Vetomag Szaritas *(Drying Hybrid Maize Seed Corn),* by Jeno Vamosi. No. 4, 1957, with summary in English. Order from Mezogazdasagi Kiado, Budapest.

Soil Survey of the Many Peaks District, Albany Road Board, Western Australia, together with a discussion on the genesis and definition of soils of the "Solonised" group, by L. J. H. Teakle. Leaflet No. 2070, 1953. Western Austraila Department of Agriculture Perth, Australia.

Mechanized Cotton Production in Alabama, by T. E. Corley, C. M. Stokes and F. A. Kummer. Circular 127, January 1959, Agricultural Experiment Station of the Alabama Polytechnic Institute, Auburn, Ala.

Using Low-Volume Farm Sprayers, by T. E. Corley. Circular 126, January 1959, Agricultural Experiment Station of the Alabama Polytechnic Institute, Auburn, Ala.

Hand vs. Mechanical Feeding of Layers, by W. E. Matson and C. H. Zuroske, Bulletin 579, February 1958. Washington Agricultural Experiment Stations, State College of Washington.

Environmental Physiology and Shelter Engineering, by R. E. Stewart and M. D. Shanklin, Research Bulletin 656, February 1958. University of Missouri, Columbia, Mo.

Ventilation and Air Conditioning for the Farm, by D. W. Works and J. E. Dixon. Farm Electrification Leaflet No. 41, April 1958. University of Idaho, College of Agriculture, Extension Division, Moscow, Idaho.

Peanuts, Harvesting and Curing the Windrow Way, by W. T. Mills and J. W. Dickens, Bulletin 405, April 1958. Agricultural Experiment Station, North Carolina State College, Raleigh, N. C.

Agricultural Drought in New England, by Robert S. Palmer. Technical Bulletin 97, Agricultural Experiment Station, University of New Hampshire, Durham, N.H.

King-Post Nailed Trussed Rafters, by E. George Stern. Bulletin No. 36, January 1959, Virginia Polytechnic Institute Wood Research Laboratory, Blacksburg, Va.

Improved Dairy Housing, by J. Donald Wadsworth, Lloyd R. Hunsaker, Lyman H. Rich and George Q. Bateman. Extension Circular 268, Utah State University, Logan, Utah.

Mulch Farming to Conserve Soil and Water, by J. T. McAlister. Copies may be obtained by writing to the author, Drawer 504, Orangeburg, S. C.

Poultry Houses with Scissor-Type Nailed Trussed Rafters, by E. George Stern, Bulletin No. 34, April 1958. Virginia Polytechnic Institute, Wood Research Laboratory, Blacksburg, Va.

Cooling Eggs to Preserve Quality, by J. T. Clayton and J. W. Hough, Publication No. 319. Cooperative Extension Service, College of Agriculture, University of Massachusetts, Amherst, Mass.

Controlled Atmosphere Apple Storage, by F. W. Southwick and J. W. Zahradnik, Extension Bulletin No. 322. Cooperative Extension Service, College of Agriculture, University of Massachusetts, Amherst, Mass.

Pole-Frame Farm Buildings, by A. W. Riddolls. Bulletin No. 338, September 1957. For copies, address the Secretary, Canterbury Chamber of Commerce, P.O. Box 187, Christchurch, New Zealand.

(Continued on page 174)

MANUFACTURERS' LITERATURE

Literature listed below may be obtained by writing the manufacturer.

Single-Phase Motors

Robbins & Myers, Inc., Springfield, Ohio — A new bulletin 470-B describing the company's new, expanded line of integral horsepower single-phase motors available in ratings from ¾ to 20 hp. The line includes open protected, totally enclosed fan-cooled and explosion-proof frames. The bulletin outlines weathering treatment to make motors suitable for use in damp, dirty or corrosive atmospheres without need of other protection. Tabulated ratings, dimensions and weights are also included.

Combines and Hay Rakes

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis. — Leaflet TL-2034 describing Gleaner-Baldwin combines for 1959, includes description of models A, R, and B-Rice special, including new quick-detachable headers, and gives specifications for models A and R. Leaflet TL-2051 describes the No. 77 parallel-bar mounted, and the No. 7 side rake and tedder (trailed) rakes. Includes applications and complete specifications of each product.

Portable Irrigation Equipment

Aluminum Co. of America, 769 Alcoa Bldg., Pittsburgh 19, Pa. — A 24-page book "Pipelines for Profit" covering portable irrigation equipment, including aluminum tubing, couplings, sprinklers, etc., and their adaptation to various furrow and sprinkler irrigation systems.

Engine Bulletins

Hercules Motors Corp., Canton, Ohio — Three bulletins describing, respectively, 4, 6 and 3-cylinder models of new interchangeable overhead-valve engines designed for use with gasoline, kerosene, LP gas or natural gas. These engines range in size from 45 to 131 hp.

Sintered Nylon Parts

Halex Corp., 26302 W. 7 Mile Rd., Detroit 40, Mich. — A 4-page brochure on nylon components formed by cold pressing and oil sintering nylon powders in a process similar to that used in forming powdered metal parts. The bulletin includes property and application data on standard oil-impregnated parts with inorganic fillers designed for new or improved uses for nylon.

Diesel Engines

Detroit Diesel Engine Division, General Motors Corp., 13400 W. Outer Drive, Detroit 28, Mich. — An 8-page brochure containing comparative information relative to the diesel's thermal efficiency, fuel energy value and costs, reliability, ruggedness, durability, safety and braking.

High-Speed Flexible Shafts

Stow Manufacturing Co., 39 Shear St., Binghamton, N. Y. — This 2-page bulletin, No. 590, gives dimensional data on all sizes of high-speed flexible shafts, as well as information on the torque ratings in different bends and the maximum operating speeds.

Thermoplastics Brochure

Westlake Plastics Co., Lenni Mills, Delaware Valley, Pa. — An illustrated brochure on Alphalux Thermoplastics. The brochure contains illustrated, detailed literature on Acrylux, Fluorolux, Styrolux, Hi-Styrolux, Ethylux, and Ultra-Ethylux, the six materials comprising the Alphalux Thermoplastics manufactured by the company.

Fence Products

U.S. Steel Corp., Steel and Wire Div., Rockefeller Bldg., Cleveland 13, Ohio — A 41-page catalog "American Fence Products" listing fence and kindred products, includes also information and specifications on bale ties, corn cribs, hardware cloth, nails, roofing sheets, welded wire fabric, stone wire, trellises and agricultural wire rope.

Flexible Coupling Catalog

Acme Chain Corp., 821 Main St., Holyoke, Mass. — A new catalog on flexible couplings containing helpful information on the various types of Acme couplings, dimensions, list prices, horsepower ratings, and other information.

Moisture Meter

Industrial Instruments, Inc., 89 Commerce Rd., Cedar Grove, Essex County, N. J. — This 6-page folder describes and illustrates the Bouyoucos Moisture Meter, designed as an easy-to-use method for eliminating guesswork and water waste.

New Holland Products

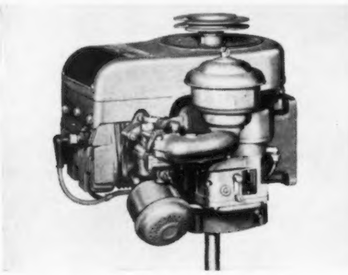
New Holland Machine Co., New Holland, Pa.—Three brochures giving information on the company's latest grassland machinery. A 4-page folder describes their balers, rakes, mowers, conditioners, crop drying equipment, crop handling equipment, production-line silage equipment and manure spreaders. A second brochure details information regarding the company's New Hayliner 67 and Super Hayliner 68. A third folder gives information regarding their Super 55 Rolabar rake. All are illustrated in color. *(Continued on page 175)*

. . . New Products

(Continued from page 166)

Vertical-Shaft Engine

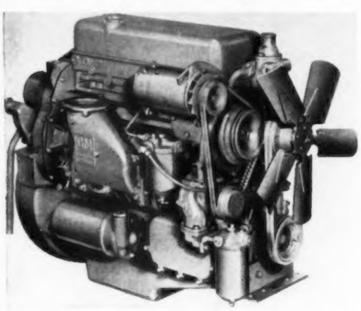
Wisconsin Motor Corp., Milwaukee, Wis., announces that it has added to its line of engines a vertical-shaft engine which



has a power range from 2½ to 6 hp at 1600 to 3600 rpm. A larger model has a range from 3½ to 7 hp in the same speed range. Features include tapered roller main bearings, forged aluminum connecting rod, counter-balanced and heat-treated drop-forged crankshaft, removable aluminum cylinder head and replaceable valve-stem guide. Lubrication is supplied by a vane-type oil pump which furnishes spray in the crankcase. A built-in mechanical flyball governor is furnished as standard equipment and requires no oiling or adjusting. Ignition is supplied by a dust and weather-sealed, outside-mounted, high-tension magneto with impulse coupling which is furnished as standard equipment. The impulse coupling produces a strong spark to permit easy starting at low cranking speed.

Expands Diesel Line

Detroit Diesel Engine Div., General Motors Corp., 13400 W. Outer Dr., Detroit 28, Mich., announces expansion of its

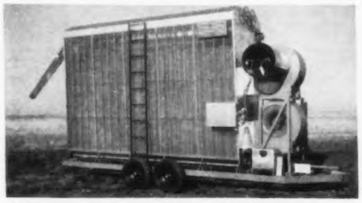


line of two-cycle diesel engines ranging from 20 to 1650 hp. The addition includes eight new V and in-line engines. In the lower power ranges, the new additions introduce an entirely new group of engines known as the "53" series which resemble the series "71" engines, but are smaller and lighter in weight with a range in power from 20 hp to a maximum of 195 hp. In this series are in-line units of 2, 3, and 4 cylinders and a 6-cylinder V engine of 195 hp maximum.

In the higher power ranges four new V-type engines of 6, 8, 12 and 16 cylinders ranging from 252 to 675 maximum hp are introduced. Also the 12-cylinder (12V-71) and the 16-cylinder (16V-71) are twinned to produce 1008 and 1350 maximum hp, respectively. When turbopowered the latter unit is said to boost maximum horsepower to 1650.

Continuous-Flow Grain Drier

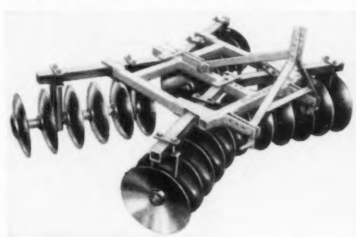
The Hume-Fry Co., Inc., Garden City, Kans., announces a new line of continuous-flow grain driers, in which the grain is



heated, dried and cooled in one continuous flow through the drier, the rate of flow being regulated by a single hydraulic valve. The grain columns are constructed of heavy galvanized screen wire and all sheet metal is galvanized. The drier can be powered by a 2 or 3-plow tractor, electric motor, or gasoline engine. The burners will use either natural gas or liquefied propane and can be easily converted from one to the other. Fans are of the centrifugal-pressure type.

Lift Disk Harrow

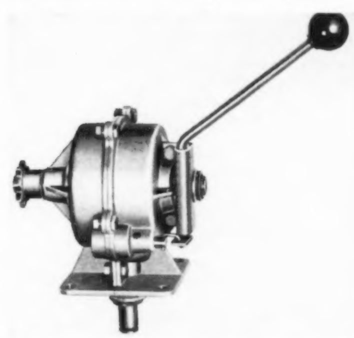
Martin Steel Corp., Mansfield, Ohio, announces a new lift disk harrow developed by its Dunham Div. for 3-point-hitch trac-



tors. It comes in two models: the standard model and the deluxe lift disk with triple-sealed ball bearings. It has a tubular welded steel frame to provide rigid strength. Features include fast gang adjustment and a wide range of cutting widths. Sealed bearings are optional.

Reversing Transmission

J. B. Foote Foundry Co., Fredericktown, Ohio, announces a small, low-cost reversing transmission now being mass produced.



This transmission is designed specifically for requirements of riding lawnmower and other vehicle manufacturers using engines up to 5½-hp capacity. It is a right-angle drive, 2⅜:1 ratio, weighs 7 lb, has one forward, one reverse speed and neutral. The unit is regularly furnished with lever and an 8-tooth No. 41 hardened steel roller chain sprocket. The unit is lubricated for life.

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Buzzell, John R.—Asst. engr., Allis-Chalmers Mfg. Co. (Mail) 1105½ Ridge St., La Porte, Ind.

Byrnes, Mark K. — Chief project engr., Massey-Ferguson Ltd., Toronto 3, Ont., Canada

Carroll, James R. — Agr. engr., rural electrical dev. rep., T.V.A., Wilson Dam, Ala. (Mail) 2158 Norwood Blvd., Florence, Ala.

Gibb, John A. C.—Lecturer in farm mechanization, University of Reading, Reading, Berks., England

Greiner, Lee M. — Res. asst., dept. of agr. eng., University of Massachusetts, Amherst, Mass.

Hatzilacos, George A. — Asst. to mgr. and chief of the agr. office of the M.C.S., (at the Greek Ministry of Agriculture) Branch of Thessaly. (Mail) St. Kilkis 5—Palea, Volos, Greece

Hohnl, Kurt E. — Asst. chief agr. engr., J. I. Case Co., Clausen Works. (Mail) 1226 Lombard Ave., Racine, Wis.

Isaacson, Joel — Asst. in agr. eng., Technion, Israel Institute of Technology. (Mail) 8 Herman Cohen St., Tel Aviv, Israel

Kummerer, Richard A. — Sales engr., Agricultural Chain Division, Chain Belt Co. (Mail) 16410 Betty Lane, South Holland, Ill.

McMillan, William D. — Jr. res. engr., dept. of irrigation, University of California, Davis, Calif.

Martin, Lewis L. — Agr. engr., Ft. Apache Indian Agency, Box 428, Whiteriver, Ariz.

Neal, Wilson F. — Civil engr., SCS, USDA, 210 Frankland Bldg., Jackson, Tenn.

Pope, John W. R., Jr. — Sales engr., Continental Gin Co. (Mail) 3556 E. Washington Ave., Fresno 2, Calif.

Rigsby, James B. — Training mgr., Monarch Equipment Co., P.O. Box 2157, Louisville, Ky.

Richardson, John R. — Rural rep., Virginia Electric and Power Co., P.O. Box 1194, Richmond, Va.

Rossi, John A. — Pump tester, Pacific Gas and Electric Co. (Mail) 258 N. Fulton, Fresno 1, Calif.

Seiple, J. Waldo — Project engr., John Deere Tractor Research and Engineering Center, P.O. Box 270, Waterloo, Iowa

Steffen, Sylvester L. — Res. and promotional coordinator of Harvestall Industries. (Mail) Dept. of Botany, Iowa State College, Ames, Iowa

Tagg, William S. — Mgr., bldgs. and equip. dept. of farm supplies, Pennsylvania Farm Bureau Coop. Assn., 3609 Derry St., Harrisburg, Pa.

Taylor, Sterling A. — Prof. of physics and soil science, Utah State University. (Mail) 520 South 6 East, Logan, Utah

TRANSFER OF MEMBERSHIP

Henkin, Ezra N. — Acting chief eng. advisor, Soil Conservation Div. (Mail) Hofit, Kfar Vitkin, Israel (Associate Member to Member)

Meyer, L. Donald — Agr. engr. (SWCRD, ARS), USDA. (Mail) Agr. Eng. Bldg., Purdue University, Lafayette, Ind. (Associate Member to Member)

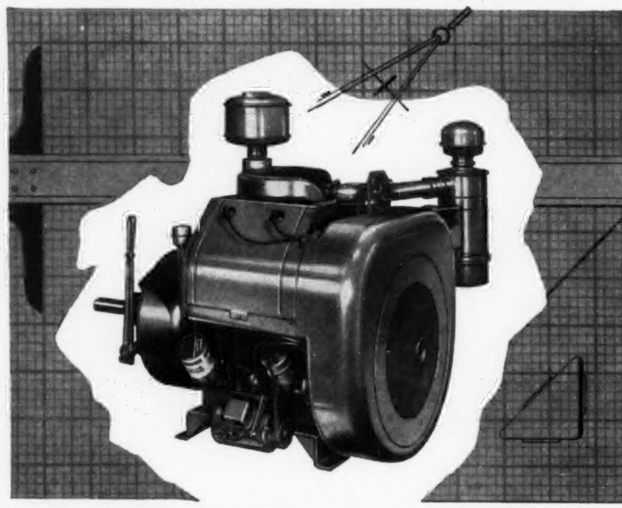
Twist, Oliver M. — Head checker, Caterpillar Tractor Co. (Mail) R.R. 1, Washington, Ill. (Associate Member to Member)

. . . New Bulletins

(Continued from page 171)

Comparative Efficiency of Two Methods of Windrow-Harvesting White Clover Seed, by A. W. Riddolls and D. L. King. Reprint from Journal of Agricultural Engineering Research, Vol. 2, No. 3, 1957. Copies may be obtained from the Secretary, Canterbury Chamber of Commerce, P.O. Box 187, Christchurch, New Zealand.

Potato Harvesting Machinery, by G. G. Lindsay. Bulletin No. 345, April 1958. For additional copies write to the Secretary, Canterbury Chamber of Commerce, P.O. Box 187, Christchurch, New Zealand.



PERSONNEL SERVICE BULLETIN

NOTE: In this bulletin, the following listings current and previously reported are not repeated in detail; for further information see the issue of AGRICULTURAL ENGINEERING indicated. "Agricultural Engineer" as used in these listings is not intended to imply any specific level of proficiency or registration as a professional engineer. Items published herein are summaries of mimeographed listings carried in the Personnel Service, copies of which will be furnished on request. To be listed in this Bulletin, request form for Personnel Service listing.

POSITIONS OPEN — 1958 — OCTOBER — O-321-832. NOVEMBER — O-330-834, 331-835, 343-857, 344-838. DECEMBER — O-352-839, 349-841, 349-842, 362-844. 1959 — JANUARY — O-418-845. FEBRUARY — O-13-901.

POSITIONS WANTED — 1958 — OCTOBER — W-314-52, 315-53. NOVEMBER — W-332-55, 324-56, 339-59, 318-60. DECEMBER — W-347-61, 345-62, 346-63, 358-64, 363-65, 364-66. 1959 — JANUARY — W-355-67, 383-68, 411-69, 412-70, 406-71, 419-72, 422-73. FEBRUARY — W-9-1, 17-2, 22-3, 23-4, 20-5.

NEW POSITIONS OPEN

AGRICULTURAL ENGINEER (graduate research assistant) for half-time work and half-time graduate study toward MSAE. Work will be helping extension agricultural engineer prepare literature for rural electric extension program at a north central state college. BSAE. Initiative. Ability to work with others. Desire and ability to do graduate work. Two weeks vacation per year. Salary $2400 for 12 months. O-35-902

AGRICULTURAL ENGINEERS (graduate fellowships) to work for MSAE with concentration on cotton ginning engineering, in a southeastern state college. Age under 35. BSAE or BSME. Acceptable for admission to graduate school. Interest in cotton ginning research or education. Application deadline for 1959-60 school year, April 1. Salary $2500 for 12 months. O-38-903

AGRICULTURAL ENGINEER for product design and general engineering in livestock equipment manufacture. Midwest location. No age limit. Must be fully acquainted with metal working machines and livestock equipment. Advancement according to ability. Salary open. O-39-904

AGRICULTURAL ENGINEER for design and development work on tillage and seeding machinery with major full line manufacturer in Midwest. BS degree in agricultural engineering. Minimum of 2 years experience in machine design. Usual personal qualifications for engineering work with manufacturer. Salary open. O-411-905

AGRICULTURAL ENGINEER for teaching, (half-time) and research (half-time) in farm structures at an eastern state university. Teaching load shared with other staff members. Wide choice of new and challenging research projects. PhD with BSAE or equivalent preferred. MS with experience considered. Farm background and some teaching or research experience desired. Cooperative man with initiative, strong desire to get practical answers to problems, and willing to accept responsibility. Unlimited opportunities for cooperation within the department and with other departments on research projects. Physical plant and facilities excellent. Salary open, competitive for qualifications desired. O-45-906

AGRICULTURAL ENGINEER for teaching (half-time) and research (half-time) in soil and water field at an eastern state university. Teaching load shared with other staff members. Wide choice of new and challenging research projects. PhD with BSAE or equivalent preferred. MS with experience considered. Farm background and some teaching or research experience desired. Cooperative man with initiative, strong desire to get practical answers to problems, and willing to accept responsibility. Unlimited opportunity for research project cooperation within the department and with other departments. Excellent physical plant and facilities. Salary open, competitive for qualifications desired. O-45-907

NEW POSITIONS WANTED

AGRICULTURAL ENGINEER for design, development, research, sales or service in power and machinery or soil and water field, with industry or public service, in South or Midwest. Limited travel. Married. Age 24. No disability. BSAE, 1958, Virginia Polytechnic Institute. Farm background. Summer work experience with excavating firm 4 summers, with building contractor 2 summers. Active duty with Army Signal Corps 6 months. Available on reasonable notice. Salary $4500. W-25-6

AGRICULTURAL ENGINEER for design, development, research or teaching in farm structures or materials handling with industry or public service in Midwest or Southwest. Limited travel. Single. Age 30. No disability. BSAE, 1951, Kansas State College. Farm background, with 4-H and FFA experience. Self-employed in cattle and hog feeding operation past 4 years. Commissioned service in USAF 43 months, including service as navigation instructor 28 months. Available June 1. Salary open. W-26-7

AGRICULTURAL ENGINEER for machine design and development in automatic processing and handling equipment as well as heavier agricultural equipment, or stress analysis work in power and machinery, with industry or federal agency. Any location. Married. Age 24. Vision corrected by glasses. BSAE, 1957; MSAE expected June 1959, Pennsylvania State University. Farm background. Summer work experience with vegetable packer, farm equipment manufacturer and state university. Available in June. Salary open. W-32-8

AGRICULTURAL ENGINEER for research or management in soil and water field with manufacturer or consultant, preferably in Philadelphia or vicinity, or in California. Married. Age 30. No disability. BS in irrigation engineering, 1953, University of California. Experience one year on drainage problems of Naval bases, one year with Army on flood control and drainage problems in north California. In Israel 3½ years as district engineer on water supply, irrigation and drainage work. Available on reasonable notice. Salary $7500. W-33-9

AGRICULTURAL ENGINEER for development or management in product development or production control for soil and water field, with manufacturer or federal agency. South, Southwest, West or Northwest location. Married. Age 26. No disability. BSAE 1956, Mississippi State College. Part time work in agricultural experiment station one year while in college. One summer as shop manager and sales engineer with irrigation equipment distributor. With aircraft manufacturer 6 months as mathematical stress engineer, before called into Service. Commissioned service in USAF since January 1957, mostly as security and law enforcement officer. Available August 1. Salary $6,000. W-30-10

. . . Manufacturers' Literature

(Continued from page 172)

Hydraulic Bulletin

Webster Electric Oil Hydraulics Div., Racine, Wis. — A 16-page publication, bulletin H3A3, photo illustrated with detailed specifications of the company's positive displacement gear-type pumps and fluid motors and valves.

Steel Buildings in Color

Stran-Steel Corp., Detroit 29, Mich. — This 4-page brochure, No. 581-215, details information on the company's recent development of steel buildings in color with the use of a new vinyl-aluminum protective coating. A color guide is included in the brochure showing the six metallic colors of blue, rose, green, bronze, white and gray which are available.

Filtration Manual

Purolator Products, Inc., Rahway, N. J.— This 32-page booklet is prepared as a manual for designers who require data on filters and filter application. Subjects discussed are, where and why filters are used, planning filtration in advance, filtration engineering, where the designer can select a filter, and applications that call for specialized study. Price $1.00.

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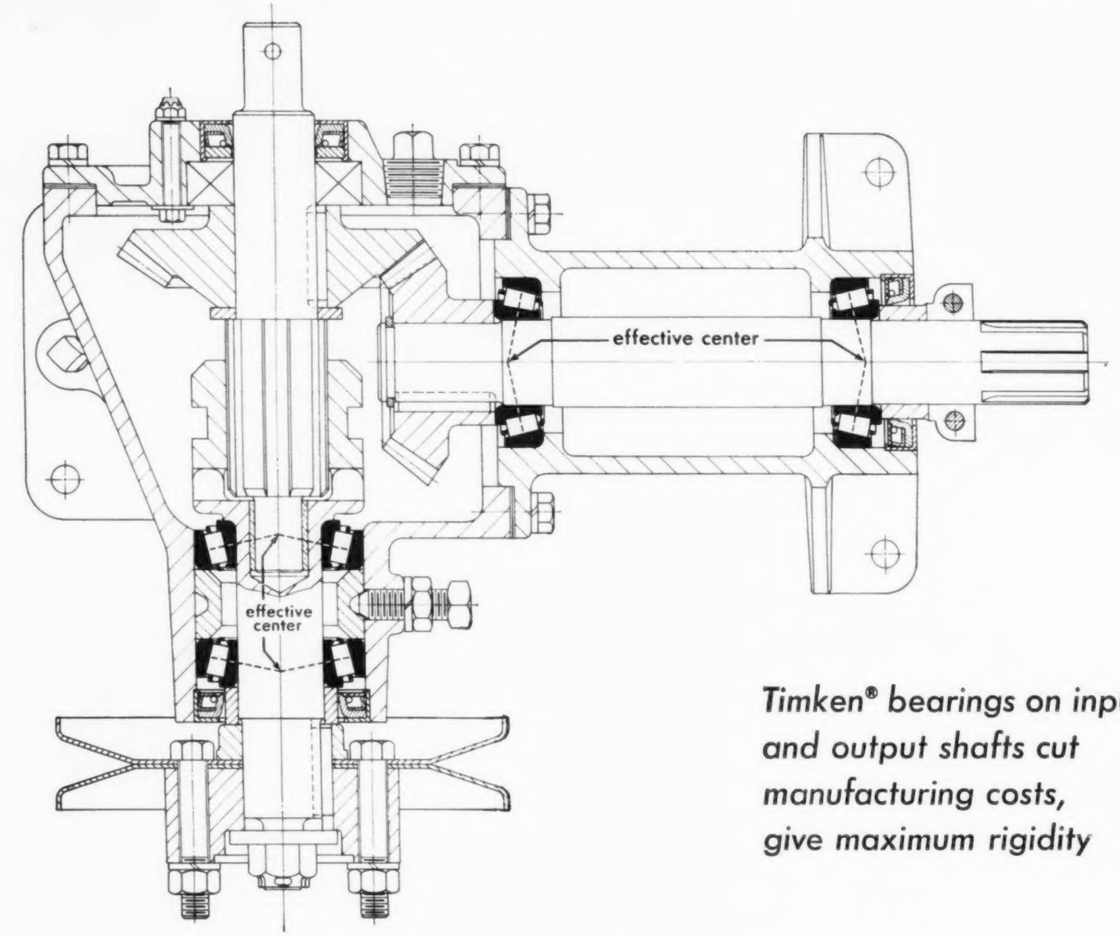
Allis-Chalmers engineers get maximum design economies with all-TIMKEN-bearing gear box



Timken® bearings on input and output shafts cut manufacturing costs, give maximum rigidity

ALLIS-CHALMERS engineers wanted to use indirect bearing mountings on both the input and output shafts in the gear box of their Model 90 ALL-CROP harvester. This would enable them to take advantage of the effective spread principle of Timken bearings (illustrated above)—obtain maximum shaft and gear rigidity. They saved costly manufacturing steps and here's how:

1) By using a simple, split collar for bearing adjustment and a snap-ring at the bevel pinion, costly drilling and tapping or threading of the input shaft was eliminated.
2) The simplified mounting of the Timken bearings on the output shaft made possible a bench assembly which facilitated bearing adjustment by simply using the nut at the end of the shaft. The bearing assembly is located in the housing through the use of a grooved cup spacer and set screw, permitting through-boring of the housing.

Simpler and more compact designs are big reasons why more and more engineers are standardizing on Timken bearings. Tapered construction lets Timken bearings take any combination of radial and thrust loads. Full-line contact between rollers and races gives Timken bearings *extra* load-carrying capacity. Shafts are held concentric with housings—making closures more effective. Dirt stays out; lubricant stays in. Timken bearings enable agricultural engineers to lick their three biggest problems: 1) combination loads, 2) dirt, 3) ease of operation—give the farmer a better, more economical machine.

For help in designing *your* new bearing applications, contact our sales engineers or write The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

NOT JUST A BALL ◯ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

The farmer's assurance of better design

TIMKEN Tapered Roller BEARING EQUIPPED